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Devoted to Commercial and Naval Motor Craft

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Frontispiece

NOTEWORTHY ECONOMICAL MERCHANT SHIPS—No. 1 (A New Series)

The motorship "AUSTRALIEN," one of the 15 large Diesel oil-engined freighters operated by the East Asiatic Company of Copenhagen, Denmark, who have sold their steamers and have contracted with six shipyards for a total of 350,000 tons d.w.c. in motorships up to 14,000 tons d.w.c. each, making half-a-million tons all-told. It is against such vessels America's merchant coal-fired, and oil-fired steamships will have to compete after the war, and that is why the U. S. A. must build no more STEAMships. The motorship "AUSTRALIEN," 410 ft. long by 55 ft. breadth, with 30 ft. 6 in. moulded depth, and is propelled by twin 6-cylinder B. & W. Diesel engines of the four-cycle single-acting class, together developing 3100 shaft horse-power. Her loaded speed at 125 r.p.m. is 11¼ knots on about 70 barrels of oil-fuel per 24 hr. day. On trials she made a speed of 12.76 knots from 3784 i.h.p. at 152.9 r.m.p. She has a d.w.c. of 9,200 tons, but can carry nearly 1500 tons more cargo per voyage than can a steamer of her dimensions, and can load and unload in about two-thirds of the time. Surely the time has come for America to build a huge fleet of these motorships. Must we delay until it is too late?

MOTORSHIP

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November, 1918 Vol. 3 No. 11

LEADING EDITORIAL CONTENTS

PRINCIPAL ILLUSTRATIONS

The oil-engined motorship has arrived! It is such a pronounced economy that it was bound to come. Nothing could stop it! And all obstacles have been removed as fast as they arose. The law of progress has seen to that. Very strong prejudices stood in the way of steam. But, one after another they were swept aside and steam reigned triumphant for a century. Steam now has had its day! Its zenith has passed, and gradually but surely it is being superseded by the economical internal-combustion power. America, the most important oil-producing country, is to be the greatest motorship-owning nation. Let us all co-operate and assist to make that day soon

EDITORIAL

INVESTIGATION AND ACTION IMPERATIVE TO THE FUTURE WELFARE OF THE NATION

WITH due regard to the numerous national shipping worries and problems saddled upon Messrs. Edward N. Hurley, Chas. M. Schwab, Chas. Piez, and other members of the Shipping Board—whom our President has made responsible for America's great merchant shipbuilding program—we respectfully exhort them that the time has come to give very serious attention to the fact that while many new hulls are or have been waiting at the docks for steam-engines and boilers months behind delivery; that, while steam-ships constantly are delayed in harbor weeks and more for bunker-coal—and that this latter situation will be worse this winter; that, while some turbine ships have been held up in shipyards because of troubles with their reduction-gears, while too much money seems to have been spent on turbines; and while the standard Emergency Fleet water-tube boiler is being abandoned in favor of the Scotch-type boiler because of the lack of skilled firemen to operate them, many responsible builders of marine crude-oil engines are clamoring for the privilege of constructing motor propelling machinery for cargo-ships. Also, of ten steamships building on the Pacific Coast for the Australian Government it has been necessary to order Diesel oil-engines for five of them, because of the delay in delivery of the steam machinery. Some new turbine steamships even are being delayed in port through troubles with their steam auxiliary machinery.

The entire motorship and oil-engine subject is one of the greatest importance to the whole nation, and for many reasons needs the closest investigation and action. Where blatant opposition to the economical oil-motor is found steps should at once be taken to ascertain the reason and have the cause removed; because there can be no doubt but that there exists a strong element striving to impede, instead of encourage and develop, further progress with this wonderful class of marine machinery, even to the extent of delaying the construction of the 36 ships for which seventy-two 750 bhp. Diesel motors have been ordered by the Emergency Fleet Corporation.

Lately the Shipping Board has had the opportunity of operating a number of large foreign Diesel driven motorships and so must have available sufficient facts to know that they are successful, although they may be veteran vessels and not of the very latest designs. What other countries can build, we can build!

From now onward it is vital to the interests of the American nation that no more coal-burning, or oil-fired, steam-driven merchant vessels be built; but that all ships hereafter ordered be motorships. We do not intimate that ships under construction shall be interfered with in any way, as such are far too badly needed for war supply purposes. Also it is no use crying over spilt-milk, of course; but, we cannot refrain from mentioning that if many of the vessels ordered eighteen months ago had been Diesel instead of steam-driven the Shipping Board's present capacity to handle badly needed war-cargoes to Europe in new American hulls would be at least 25% greater than it is.

But, there is no reason why such mistakes need be repeated now that the greatest emergency has safely been passed, and all vessels hereafter ordered must have the combined advantage of meeting war conditions and of being a type best suited to insure success of America's future merchant marine.

What will the nation say if after the war it discovers itself saddled with hundreds of merchant-ships of an uneconomical type that cannot be operated against foreign motorships without imposing a heavy burden upon the people? American steamships cannot compete against the motorships of other countries.

As we write we have just come from aboard a large Danish Diesel motorship temporarily running under the Shipping Control Committee's jurisdiction. This vessel is of but 13,400 tons displacement, 425.5 ft. length, 55.0 ft. beam and 38.6 ft. depth, yet she brought 11,400 tons, (22,800,000 lbs.) of sugar in her holds from San Francisco to an Atlantic Coast port on 240 tons of fuel-oil and with an engine-room staff not exceeding 13 men, although her bottom was badly barnacled owing to having lain in port several

(Continued on next page)

months awaiting sailing permits. This is just an ordinary performance!

A steam-ship of similar dimensions could not carry more than about 10,000 tons (20,000,000 lbs.) of sugar and would consume four times the amount of fuel, and would have nearly double the number of engine-room and boiler-room staff and would have heavier charges when in port. Therefore, how can the latter operate in competition with such an economical motorship? Is it no wonder that "Motorship's" campaign is of vital importance to this nation? As regards the present time, just think what 1500 additional tons of supplies every voyage for every ship would mean to our Allies and to our troops! With a thousand ships it would mean 1½ million tons, or about 14 million tons a year.

There cannot be the slightest doubt but that when normal commercial times return many of the new twin-screw reciprocating steamships will have their machinery placed upon the scrap-heap long before it is worn out and substituted with Diesel motors without even having as efficiently and adequately served their war purpose as they could have had they originally been oil-engine powered.

At least five experienced American Diesel motor-building plants have had the maximum part of their capacities turned over by the Emergency Fleet Corporation to the construction of reciprocating steam-engines and turbines, when it would have been wiser had they been allowed to devote their valuable experiences and suitable equipment to the building of marine Diesel engines. One of these concerns has turned out these steam engines so close to the allotted time that the boilers building elsewhere were far from completed. This firm could have built Diesel engines even more quickly, and the ships instead of waiting for the boilers and coal could have been in service carrying badly-needed war-supplies to France, and without any tell-tale trail of smoke to indicate their proximity to lurking enemy submarines.

Standardization rightly is the present slogan in the Emergency Fleet Corporation and according to a Shipping Board publicity article released on October 6 the Fleet Corporation realizes that there is need for further standardization, as the same means much to the future of America's merchant marine. Yet, the wonderful standardization features of the heavy-oil engine seems to have been given far less consideration than it deserves. With a single size of cylinder no fewer than four different sizes of reversible engines can be produced say for instance, 750 bhp.; 1000 bhp.; 1500 bhp. and 2000 bhp. for single-screw ships merely by having three, four, six or eight cylinders of the same bore and stroke. In other words vessels of **eight** different tonnages can be powered built on one size of engine-cylinder, because the other four sizes would be attained by twin screws.

How different is the case of triple, or quadruple, expansion reciprocation steam-engine, for which one size of ship alone needs three or four engine-cylinder sizes, respectively, apart from the boilers and condensers. Just realize what this means as a manufacturing and standardizing proposition. Compare it with the Diesel engine, which requires no boiler. It cannot be compared as there is no comparison, the advantage being so enormously in favor of the internal-combustion motor. How much thought has been given to this advantage?

If the full facilities of this country for building heavy-oil engines were utilized many more small steel, concrete, and wooden "emergency" ships could be built, aside from large steel motorships; for, as Mr. Piez recently intimated, the hull-producing capacity of the country in steel and wooden ships is in excess of the steam-engine and boiler output. Also we can see no real reason why a certain number of oil-engines cannot be purchased from neutral countries purely to meet the present emergency, as there are a number of responsible and willing engineering European companies who can give quick delivery on such machinery, in some cases almost immediate delivery without even drawing on the U. S. A. for steel and other materials, except a little copper and white metal for bearings. We would prefer to have engines built here; but, an emergency is an emergency, also as these concerns are willing to send numbers of expert engineers to train American operators, it would be valuable for the country to secure the experience and oil engineering data.

Due to the inherent economy of the motorship its use enables possible a conservation of the world's limited store of liquid fuel, and because its combined advantages will encourage a more extensive post-war development of industry and commerce throughout the United States, the motor-shipping subject is one that positively cannot be stopped from forcing its way to the front, and undoubtedly a huge motorship building program will be embarked upon in this country just as surely as Germany will be defeated. It only remains a question whether the steps will be taken at once, in six months, or in two years. It is "Motorship's" opinion that the change from steamer to motorship construction is much nearer than many of us believe possible, and when it does come it will sweep over the shipyards like a great tidal wave. The handwriting is on the wall and cannot be obliterated! It is up to those in charge of America's shipbuilding to show sufficient confidence and foresight and to lose no time. Then their names eventually will be inscribed on the roll of fame as men who would not load-up their country with hundreds of almost useless (after the war) and uneconomical ships; but, whose wisdom successfully produced the world's greatest maritime nation. The future business welfare of the nation is at stake, so may they respond to the urgency.

PORT ECONOMY AND ITS IMPORTANCE

IT IS well to continually bear in mind that merchant ships are built expressly to carry cargoes, and only when they actually are on the high seas are they earning dividends for their owners or charterers. So, every hour spent in port virtually is a dead loss as, when in harbor the vessel is not earning a cent on the huge amount of capital invested; but, instead is running up a big daily bill in fuel, wages, dockcharges, etc. While stays in port are imperative for the purpose of loading and unloading cargo and bunkering, every hour saved at the wharf is of the greatest importance, as also is every dollar in stand-by charges that can be saved as it adds to the annual earning power of the ship. Get the ship off to sea is the slogan. More particularly is this so with American ships because of the high wages of the crew and because of the normal greater capital cost of the hull, machinery and equipment compared with foreign vessels. Thus after the war when strong high-seas competition is in vogue port economies will be a serious proposition that will need expert study and handling.

As time goes by shipowners are becoming more and more familiar with the remarkable economy of the oil-engined motorship due to the very low consumption of fuel of the internal-combustion engine, and to the great extra cargo capacity when at sea; but, too little attention has been drawn to the striking economies effected by a big motorship in port compared with a steamship. And, the deeper one probes into the details of operating large oil-engined merchant vessels, the more impressed one becomes with the wonderful advantages derived through the use of the Diesel engine. So much so, that it seems difficult to believe that motorships have not yet come into unanimous favor throughout the entire shipowning business of the United States, and that any suggestions of imperfection would only make shipowners more keen to wipe away such possible obstacles regardless of initial cost and with all possible speed.

One can go down to the docks in America's ocean harbors and daily see big foreign motorships unload as much as 7000 tons of general cargo, re-load the same tonnage with but a total consumption of about twelve barrels of fuel-oil for the entire job, and with not more than an additional couple of barrels of fuel for ship's general use during the stay in port. Such economy may seem unbelievable to the average steamship owner, whose steamers use at least ten times that amount of oil or coal. Yet a visit to one of these ships will at any time confirm this.

It is a fault of the majority of many American shipowners, and even Government officials that they will not take the trouble to visit these motorships and learn for themselves. Some of these apparently even do not want to know about these economies; but the time will come when our private shipowners and shipowning companies will be owning and operating the U. S. Government-built fleet of steamships in the face of strenuous competition of foreign motorships. Then, when faced with possibilities of heavy financial losses, they will regret that they did not pay more attention to the economical advantages of oil-engined motor-vessels.

Another great port economy effected by the motorship is brought about by the main engines being able to start from stone-cold in a few seconds, with the result that there are no boiler-fires to be kept banked and no steam to be raised. The usual practice is to have one or two auxiliary Diesel engines connected to electric generators that furnish all the power required when loading or unloading. As these auxiliary engines also can be started in a few seconds they are only in use when actually needed and at other times are consuming no fuel. For general engine-room service such as lighting and pumping a small engine using about one gallon of fuel per hour is all that is required when the larger auxiliary engines, or main engines, are idle.

Bunkering, too, takes much less time in port with a motorship, as the latter either may bunker less often or else occupy a shorter time fueling every voyage, as 300 tons of oil-fuel will be more than sufficient to take a 5500-ton d.w.c. motorship from New York to France and return, and the simple operation of connection oil-pipes from a tanker or from the wharf and pumping such a small quantity of fuel is apparent. (See page 13.)

In these days of bunker-coal shortage this advantage is enormous and especially will be so this coming winter. During the last year, months and months of accumulated hours have been lost by Ameri-

can steamships, both ocean going and coastwise, while awaiting bunker-coal. This time lost we believe is ten times greater than all the hours lost by repairs to all foreign and domestic motorships put together including the earlier experimental ships. In this bunkering advantage the oil-burning steamer shares, but not to anything like the extent of the motorship, which has at least a 300% advantage in the bunkering alone, apart from conserving the world's limited store of liquid power, and by its inherent economy encourages a more extensive development of industry and commerce. Finally we may mention that the thirty-six new steel motorships to be built for the U. S. Emergency Fleet Corporation will be able to load and unload cargo faster than any steamship afloat.

THE AMERICAN NAVAL MOTORBOATS

IT IS no part of the work of this journal to boost any particular concern; but no doubt the Elco Company, the Standard Motor Construction Company, Ansaldo & Company, and the Sterling Engine Company, must feel highly gratified at the magnificent work accomplished by the little patrol motorboats for which they were responsible in producing, particularly those craft operating in the Italian Navy, the latest splendid feat of which being the destroying of two submarines during the bombardment of Durrazo on the night of October 2. No doubt after the war the curtain will further be lifted and other many gallant actions of motorcraft and their plucky crews revealed.

Operation of Diesel Engines in China

By HAROLD B. WILSON

[This is the first time an article dealing with stationary type heavy-oil engines has appeared in "Motorship," yet there is hardly any need for editorial apology, although perhaps an explanation will not be out of place. Extensive data concerning the operation of marine-type Diesel engines is not easily available, due to the war in Europe and due to the comparative lack of varied and extended service experience in the United States, so the valuable information given by the author will be found of considerable use to operators and designers of marine Diesel engines. It will be noticed that Mr. Wilson includes references to a motorship that visited his port. As a whole it is to be numbered among the most interesting articles ever written on the operation of oil engines. The unique part of the article is that it deals with five different makesof Diesel engines under the author's charge.—*Editor.*]

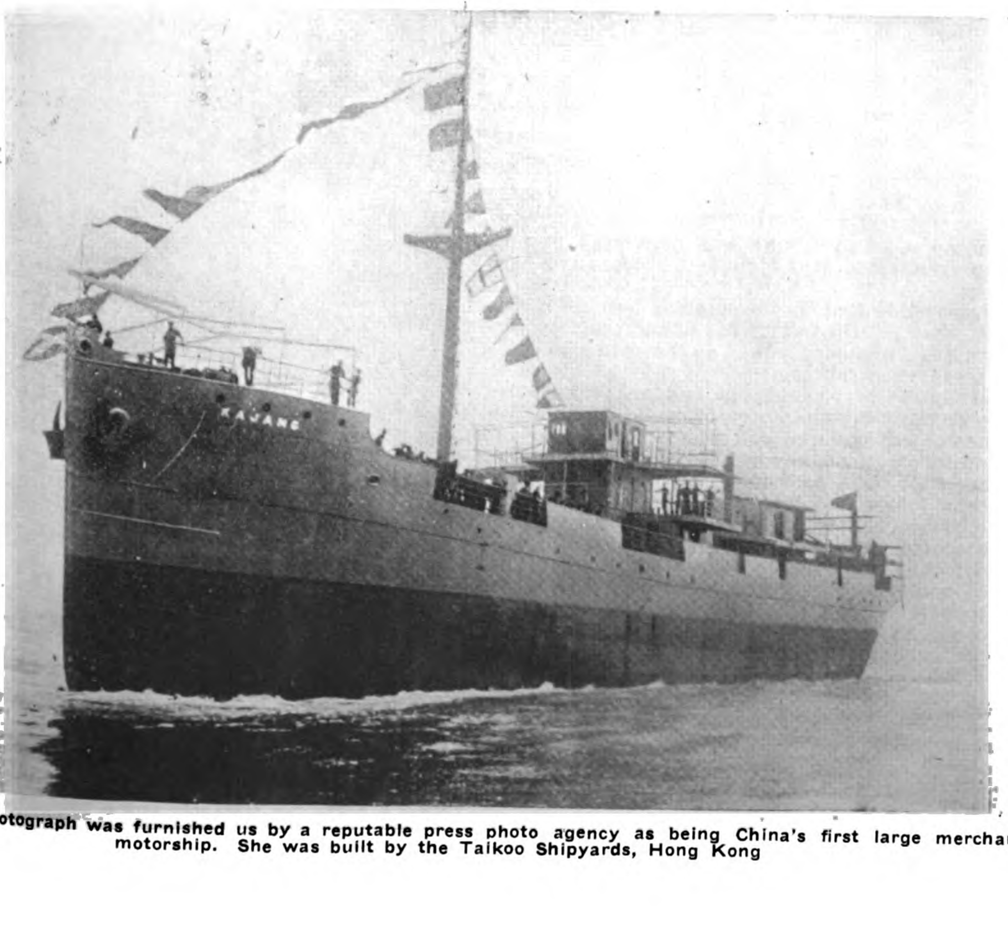
THE station at Canton is one of the most interesting power plants in existence. It consists of thirteen prime movers all direct connected to 2000 volt, 60 cycle, single phase alternators. Nine of these engines are Diesels, of five makes, ranging from 200 to 500 hp. and four are vertical, compound, condensing, steam engines all 175 hp. The total capacity of the plant is 2250 kw. As a museum this plant cannot be beaten, but as a power plant Heaven help it.

The former engineers, finding it practically impossible to make the six different ideas in governors work together, gave up the idea of parallel operation and built a distribution board similar to the plug board used, in large manufacturing establishments, for testing electrical machines. The board has thirteen horizontal alternator bus bars to which twenty feeders may be plugged. With this feeder board, the total power of the plant cannot be used to the best advantage.

The steam-plant is the poorest part of the station. It was given a temporary setting ten years ago with the idea of discarding it in a few months and has been in operation most of the time since. The boilers are not set properly, there is no way of blowing the soot off of the tubes, the furnaces are too small, the economizers cannot be repaired without considerable labor, there is no feed water heater, the condensers are too small and the engines and all accessories are in bad state of repair. To make matters worse, Chinese prove to be poor firemen. For years the foreign engineers have gone down in the boiler-room and fired the boilers to show the firemen how it should be done. Just as soon as they leave the Chinese fire to suit themselves. The only economical firing we have had was for three months when we could use crude-oil. We pay $26.00 Mex. per ton for Japanese coal and a large percentage of it goes up the flue. The company would save money if the steam-plant refused to work at all, but a great many consumers would be without light.

Our Diesel station is not ideal by any means. The engines are not set to the best advantage and the five different kinds of machines make repairs expensive, as we must carry spares for each one. A Diesel station the size of ours could be built here to run more economically than any steam station of similar size. The average oil rate in our station at all loads is about 0.8 lb. per k.w.h. and the best rate we could expect to get from a steam station operating under the same conditions would be 3½ lbs. coal per k.w.h. The lowest price that we can ever expect to get on coal is $8.00 Mex. per ton while oil costs us only $30.00 and less per ton at the present time.

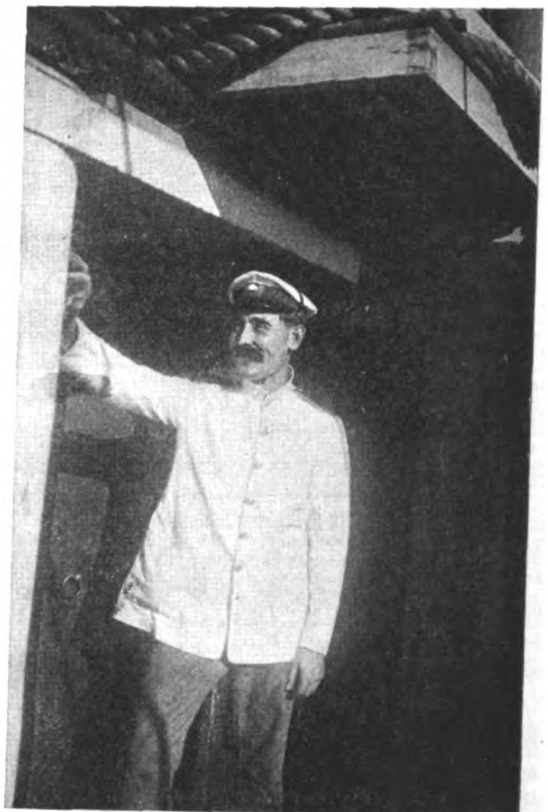
At the outbreak of the war we had on order a Sulzer-type 1200 h.p. two-cycle Diesel engine direct connected to an 800 k.w. alternator. As this engine was ordered from a German licensee of Sulzer we were unable to get it. Four of these engines direct connected to 2200-volt, 60-cycle, three-phase alternators would make a fine station. With one spare engine and a spare air-compressor there would be few interruptions in supply. This assumption is based on the operation of our station without a spare engine or compressor.



This photograph was furnished us by a reputable press photo agency as being China's first large merchant motorship. She was built by the Taikoo Shipyards, Hong Kong

A review of the operation of our Diesel engines for 1917 is seen in the table below. For obvious reasons the names of the builders are omitted, but they are of English, American and Swiss construction.

Engines	D1	D2	D3	D4	D5	D6	D7	D8	D9
Total hrs. operation	3077	3166	4172	4329	2718	3663	5258	6388	5719
Hrs. Operation per day	8.4	8.65	11.4	11.8	7.4	10.0	14.4	17.5	15.6
Total shut down during load period	1.33	6.93	2.37	7.95	2.57	19.5	12.55	56.5	43.27



The Chief-Engineer of the motorship "Vulcanus." His valves are all ground, bearings and crank-pin brasses are in fine shape, and he is going ashore for the day,—hence the smile.

With one spare engine, large enough to take the load of any other engine, the longest interruption in supply in the entire year would have been the time necessary to start the reserve engine. This spare engine would have made it possible to make repairs thoroughly by taking an engine out of operation for a few days at a time. We have rebuilt three small engines. Two were rebuilt when we had enough steam reserve to shut down one small engine. The third was rebuilt one cylinder at a time, the other two working each night. If we rebed the crankshaft it will be necessary to shut off part of the city supply.

Considering the fact that our engines are from two to ten years old and haven't received the care that they should they do very well. Any power station should have 25% reserve power, but that condition has never really existed in this plant. As fast as new units have been added they have been rapidly loaded up and the growth of business has been retarded by lack of equipment. Our

plant should be supplying 20,000 k.w. and, for a station of that size, Diesel equipment of the present day is out of the question. We have engaged engineers to design us a 20,000 k.w. turbo plant and have already bought two 2500 k.w. sets with boilers and auxiliaries.

The boiler furnaces are to be designed to burn local North River coal. It is a very fragile semi-anthracite coal and cannot be burned in any of the existing boiler furnaces out here. Mechanical stokers will largely do away with the personal element of the firemen. We will have meters installed to record the steam flow, boiler feed, CO_2 in the stack, temperature of the alternator coils, volts and k.w. Each morning the engineers can take the charts and check up just what the station has been doing in the past twenty-four hours.

When an engineer comes into a station like we have in Canton, with its nine Diesel engines of five makes and four cylinder sizes and most of the engines in a bad state of repair, it is necessary for him to make a study of the individual engines and then make comparisons between them, so as to get the best results in overhauling the machines. With that in view the writer made the table given below. The first five types of engines are the ones in our station at the present time and the sixth is a two-cycle Junkers type engine on which the author was fortunate enough to work while it was being developed.

Column	1	2	3	4	5	6
Engines	D1 D2 D3	D4	D5 D6	D7	D8 D9	Junkers type.
Construction (All vertical)	"A" Frame	"A" Frame	"A" Frame	"A" Frame	"A" Frame	Closed base.
Bore	12″	14 11/16″	15″	18″	22″	9 1/2″
Stroke	18″	21 3/8″	22″	26″	30″	20″
Pis. Dis. Per cyl. (Ft.^{3})	1.18	2.22	2.25	3.82	6.0	.82
No. Cyls.	4	3	3	3	3	2
R. P. M.	257	180	180	180	180	485
H. P. (Rated)	200	200	200	308	500	225
△ (Ft.^{3} per H.P. per min. Pis. Dis. Power Strokes)	3.02	3.00	3.04	3.34	3.24	3.52
M.U.P. (Rated) lbs. per sq. in.	75.6	76.2	75.2	68.5	70.6	65.0
Flywheels (Gar. Cyclic Irregularity 1—250) Dia.	8′0″	9′10 1/4″	9′10″	11′8 1/2″	11′6″	52″
Rim. Inetia (Ft. lbs. per sec.)	885,000	930,000	789,000	1,626,000	2,110,000	
Inertia per H.P.	4,400	4,650	3,900	4,930	3,910	
Wrist Pin Bearing (D X L)	4 1/4 x 6 1/2″	5 1/8 x 7 11/16″	5″ x 7 1/8″	6 1/4″ x 9″	6 1/2″ x 11″	
Mean Press. (From M.U.P.) $/in^2$	312	335	337	310	343	
Lubrication	Wiped from	cylinder wall			Forced	
Crank Pin Bearing (D X L)	6 3/8″ x 7″	7 11/16″ x 8 3/4″	7 7/8″ x 8 1/2″	11″ x 11″	11 1/2″ x 12″	
Mean Press. (From M.U.P.) $/in^2$	181	195	196.5	145	177	
Lubrication	Annular	rings on	crank and	oilcup	Forced	Forced
Main Bearing. (D X L)	6 1/2″ x 14″	7 7/8″ x 17 1/8″	7 7/8″ x 17″	11″ x 22″	11 1/2″ x 24″	
Mean Press. (From M.U.P.) $/in^2$	88.7	99	98.2	72	88	
Lubrication	Oil rings	supplied	by cups			Forced
Exhaust Valve. Clear Dia.	3 3/4″	5″	5 1/8″	4 1/4″	7″	
Stem (Dia.)	3/4″	1″	1″	1″	2 3/8″	
Skirt (Dia.)					5 1/4″	
Clear Area (in^2)	10.56	18.91	19.71	13.41	16.9	
Velocity through valve (Ft./min.)	8,250	6,000	5,920	14,700	18,300	
Lift	1 3/16″	1 1/8″	1 13/32″	1 1/4″	1 3/4″	
Cage Port Area	11.4	17.75	18	19.75	28.5	
Velocity through Port (Ft./min.)	7,630	6,470	6,300	10,000	10,900	
Capacity of Air Comp. (Ft.^{3} free air per H.P.)	.232	.4	.400	.26	.315	.425

On the table, the mean useful pressure instead of the mean effective pressure is used. It is the figure with which many designers of combustion engines work at the present time. A large percentage of motor concerns do not own manographs (optical indicators) and it is impossible to get indicator cards on a high speed motor without one. M.U.P. is derived by substituting B.H.P. for I.H.P. in the formula I.H.P. = PLAN ÷ 33,000. P is then the mean useful pressure instead of the mean effective pressure, △, or cubic feet power, piston displacement per min. per H.P., is gotten by dividing 229 by M.U.P.

The "A" frame construction is used on all of the engines in this station. Each cylinder on D8 and D9 has four steel columns to reinforce the frames. "A" frame offer some advantages from the manufacturers' viewpoint. They can build engines of several different horse powers by adding cylinders, the bed plate, crankshaft, camshaft, fuel pumps and air compressors being about the only parts not standard. These engines are rather hard to get at and do not lend themselves so nicely to forced lubrication. The older builders of Diesel engines are now using the closed or box base type. The marine engine people are far ahead of stationary manufacturers in this respect. They can remove covers large enough for a man to work easily and comfortably. On the Werkspoor-Diesel engined motorship Vulcanus half of the crankshaft may be removed without disturbing the cylinders at all. This accessibility would be a great advantage in stationary engines, it saving labor, time, and expense.

In rating Diesel engines of proper design three cubic feet piston displacement (power strokes) per H.P. per minute (△) seems to be about right. When they are in good running condition, D4, D5 and D6 carry that load very easily. D1, D2 and D3 will run at that rating but the exhaust valves go bad occasionally. The exhaust valves on D7 are too small to allow the engines to produce the power that it should. By a change of shape on the exhaust toe cams and a reduction in the size of the valve skirt, the output of D8 was increased from 475 h.p. to 550 h.p. making the rating 2.95 cubic feet per h.p. minute. On test, the first two Junkers type engines referred to in the table, carried 280 h.p. continuously for two hours with no signs of trouble appearing. No governor adjustments or any other adjustments were made for the test so that the speed fell off to 475 r.p.m. The engine was delivering power at the crankshaft at 2.7 cubic feet per h.p. per minute.

It is possible that as the engines become more refined that △ will fall to 2. Racing automobile motors have produced power at the rating of 1.85 and some even better.

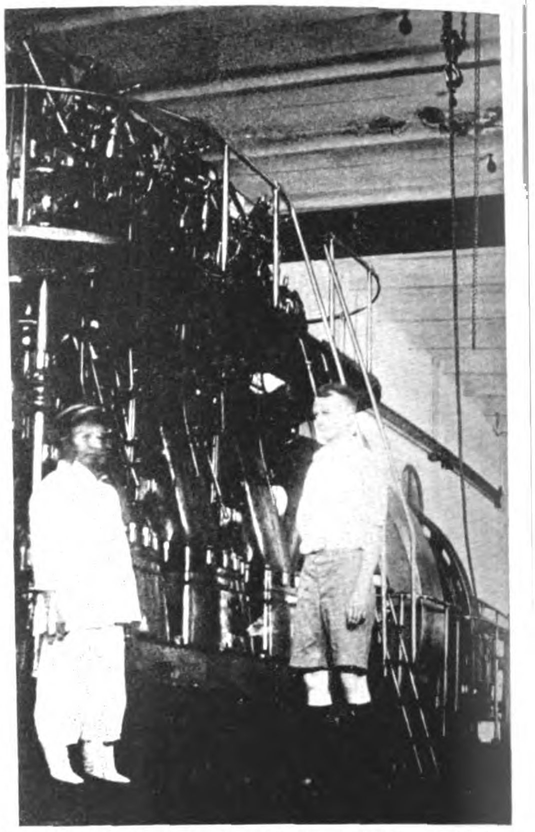
The flywheels on our engines are extremely heavy to meet the guarantee of cyclic irregularity of one in two hundred and fifty. The maker of D8 and D9 said that they had never put such heavy flywheels on engines before. For marine work very small flywheels may be used.

We use phosphur bronze when we replace wrist-pin bearings. These bearings are cast in a Chinese foundry and prove to be very satisfactory. For crank and main bearings we use a tin base white metal gotten from the Great Western Refining Co. in U. S. A. For years the former engineers experienced a great deal of trouble with these bearings and tried many different kinds of metal. This trouble disappeared when they started using Great Western. The former metals used were probably of lead base which is generally not tough enough for Diesel work, if it is hard enough to resist squashing at the high working pressures.

In the design of a four-cycle Diesel engine nothing is more important than the valves and their passages. Many cracked heads are due directly to some error in the valve design. The velocities through the valves should be kept as low as possible and in no case should it exceed 10,000 feet per minute. Sharp bends and reduction in area and sudden changes of section should be avoided. Engines D4, D5 and D6 have velocities as low as 6000 feet per minute and on these engines valve trouble is reduced to a minimum. *D_4 has been in operation for ten years* (it is now being rebuilt) *and valve trouble occurs very seldom. It has never had a cracked head.*

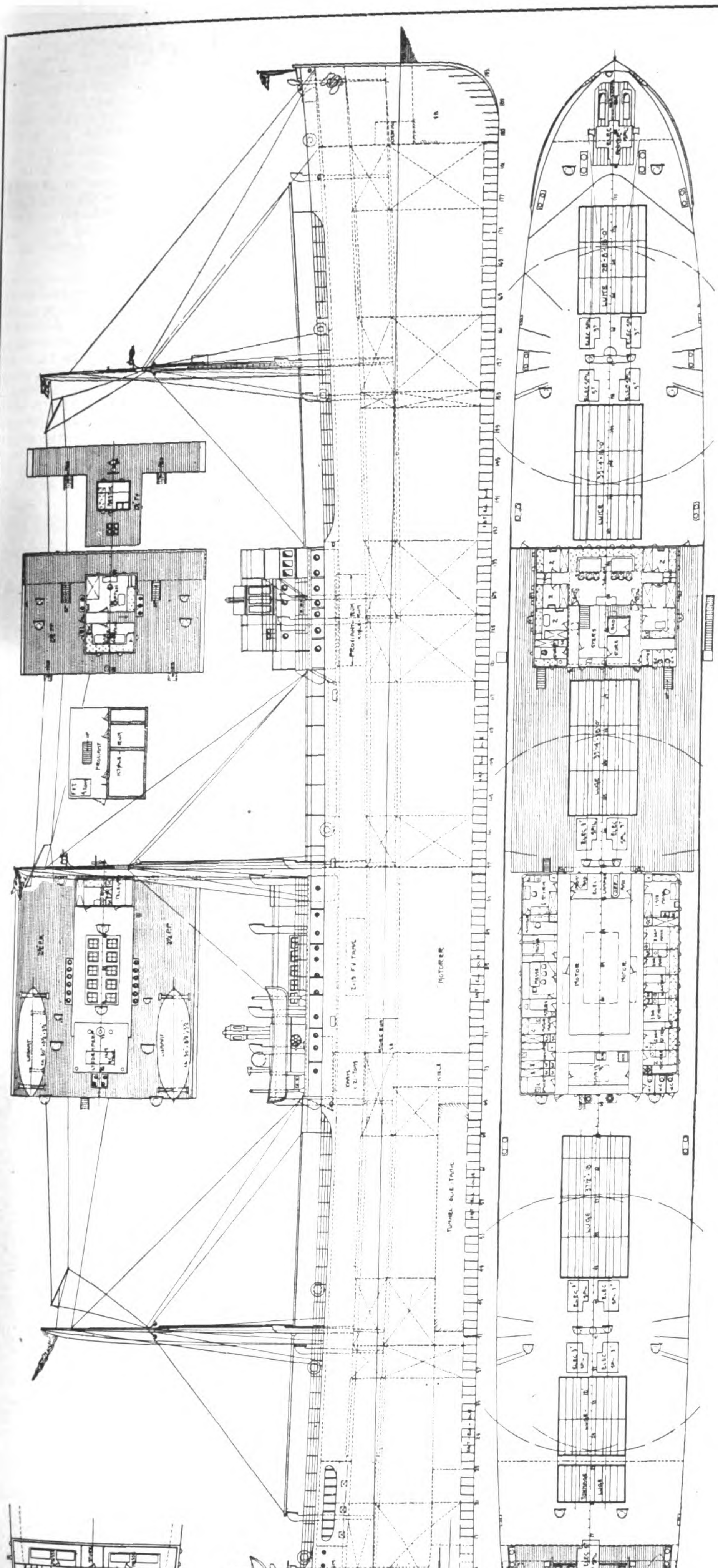
Cracked heads have occurred twice in six years operation on the engines of column 1 in the table. When these engines are operated at full load continuously the valves warp and the springs on the exhaust valves soften.

(To be continued.)



Mr. H. B. Wilson (author of this article) and his No. 1 station fitter. The engine shown is a 500 b.h.p. at 180 r.p.m. Lyons-Atlas Diesel, coupled to a S.E. 2200 volt, 3 phase 60 cycle alternator with direct-connected exciter and Ingersoll-Rand compressor

Yim, a first-class mechanic and a good Diesel engine man; and Fung, a remarkably clever station man. Has many good ideas all of his own



THE DANISH MOTORSHIP "GEORGE WASHINGTON"

She recently carried 10,000 tons of sugar from the Sandwich Islands to San Francisco in 8 days on a fuel consumption of 84 tons (588 barrels) of oil. Length, 425' 5"; breadth, 55' 3"; depth, 27' 7". Details are given on another page.

"Glenapp," a 6600 H. P. British War-Production Motorship

New High-powered Diesel-driven Merchant Vessel of About 12,000 Tons D.W.C.

Frequently we have referred to large motorships under construction during the war in British shipyards, particularly those building for the Glen Line, and recently we described the big Cunard oil-carrying freighter "Santa Margharita," a new steel motorship of about 11,000 tons d.w.c., which is one of the biggest Diesel-driven vessels afloat.

This craft, however, is not the largest of this type recently turned out in England, for this year there has been built at Barclay Curle & Company's yard at Glasgow the MS. "Glenapp," a steel motorship of about 12,000 tons d.w.c. The trials were run early in September last. For several reasons this cargo-ship is of interest, one being her size and speed, the other being that the builders of her engines have gone back to eight cylinders. In this respect it may be remembered that the earlier B. & W. Diesel engines had eight cylinders, and the latter engines had but six cylinders, so the return to eight cylinders will excite more than ordinary interest.

"The Glenapp" is the vessel in which the two 3300 h.p. B. & W. four-cycle type Diesel engines referred to in our June issue have been installed, and which motors were built at the Lancefield Quay Diesel Engine Works of Harland & Wolff at Glasgow, Scotland, under B. & W. license. It means that this ship has a total propelling power of 6,600 h.p., or equal to the largest engines on order at the parent factory in Copenhagen. Our information gives this as *brake* horse-power, but we are inclined to think that is *indicated* h.p.

The dimensions of the "Glenapp" are as follows:

Length	450' 5"
Breadth	55' 8"
Depth	36.6
Gross Tonnage	7,263 tons
Dead-Weight Capacity	12,000 tons
Power (twin-screws)	6,600 H.P.
Power per Cylinder	411 H.P.
Speed (Probable)	14½-15 knots

The report that reached us also gives the d.w.c. as being of 10,000 tons; but if one may use the gross tonnage, as given by Lloyds, as a criterion, the capacity must be nearer 12,000 ton d.w.

In addition to the two propelling engines there must be at least another 750 b.h.p. for the auxiliary compressors, and for driving the electric generators for operating the electric cargo-winches, electric capstan, and electric steering-gear, etc.

The vessel is rigged with four masts, three of them being practically derrick posts for the handling of the cargo. The accommodation below decks has been carried out on most modern lines, there being messrooms for officers and engineers, and separate living rooms for each four members of the crew. The "Glenapp" is, indeed, a good example of the very marked progress made in this type of vessel; but, unfortunately, we have nothing in America to compare with her, with the possible exception of the U. S. Navy tanker "Maumee."

Other large Diesel motorships built by Harland & Wolff during the war are the "Glenamoy," "Glenavy," "Glengyle,' and "Glenartney," which range from 5075 gross tons upwards. For instance, the MS. "Glenavy"—one of the smallest of this interesting fleet—is of 5075 tons gross register, and is fitted with twin six-cylinder 24 13/16 in. bore by 33½ in. stroke, B. & W. type Diesel engines. Her length is 35 ft. 1 in. by 52 ft. 2 in. breadth.

In connection with the MS. "Glenapp," there is a distinct moral for the U. S. Emergency Fleet Corporation to bear in mind. Here we have the British nation far harder pressed with war work, shortage of labor, and materials, than is America, yet one of the best known of British shipbuilders manages to construct this year the largest and highest-powered cargo motorship yet built in the world. What can the U. S. A. to-day show in motorship construction that can compare with this latest British creation? What single merchant ship in the entire American mercantile marine—either built or building—could operate (in normal times) on the same route as the MS. "Glenapp" and carry freight at the same low rates and show a profit? Or what tanker under the Stars and Stripes—other than the U. S. "Maumee"—could operate in competition with the British MS. "Santa Margharita"? We have got to wake up and get busy, or at the end of the war be saddled with uneconomical steamships that we cannot afford to operate.

LARGE BRITISH SHIPYARD

There are now no fewer than 21,550 employees at the Harland & Wolff Belfast shipyard. All together this large British shipbuilding company at their various yards employ 40,000 hands, and the aggregate wages paid now total $625,000 per week. Harland & Wolff are the most important Diesel motorship builders in Great Britain.

Oil Engines Make Possible Great Concrete Fleet

By ROY H. ROBINSON

(of J. C. Robinson & Son, Chicago, Ill.)

CONCRETE ships—the one romantic development of a World War,—are we to have them or are they to be left a popular dream? To-day, they are a Phantom Fleet. And why? Mr. Charles M. Schwab, Director-General of the Emergency Fleet Corporation, when recently on the Pacific Coast made the following noteworthy statement: "If I could wave a magic wand and bring into existence 10,000 concrete ships I would do so at once." Mr. Edward N. Hurley, Chairman of the United States Shipping Board still more recently issued the following statement: "I would build more concrete ships than Carter had oats if the concrete bottoms would run by themselves."

The merit of the reinforced concrete ship, concerning which the hesitating ones so often shook their heads, has been established, the doubts disposed of. The structural soundness of the concrete ship, its qualifications to meet the test of the high seas, have been conclusively established, not by engineering knowledge alone, but by the splendid demonstration of the 5,000 ton concrete ship "Faith," fighting her course for two days into the seas of a sixty mile gale.

Thanks to the scientific instruments designed by Professor McMillan, serving with the Concrete Division of the Shipping Board, and installed in the "Faith" for her maiden voyage, little was left to conjecture. These strainographs, throughout this first and supreme test of ocean storm waves upon a large reinforced concrete cargo ship, automatically recorded the stress of every wave upon the hull. The record was conclusive,—a maximum recorded strain of 6,000 pounds per square inch in steel reinforcing designed to safely carry 16,000 pounds.

The "Faith" has made her second ocean voyage, this time to far off Chile, and soon she will be enroute to New York with a cargo of Chilean nitrate which will make munitions for our men in France. Each such trip means so much increased support to our khaki lines,—means just so many more of those khaki boys who will come back home alive. Each such additional "Faith" now built means just so many casualty lists saved in France by increasing the effectiveness, the intensiveness of our warfare, and the shortening of the battle by just so much.

All along the battle line to-day we have but one cry, the cry for **steel**,—steel, the key to all success in every war maneuver. The War Industries Board is to-day faced with a steel crisis, a demand for the last six months of 1918 amounting to 25,000,000 tons, with an available supply in sight of only a possible 17,000,000 tons! That is why the Concrete Ship is needed to-day more than ever before, for the Concrete Ship means conservation of steel. One million tons of steel bars, and bars made from the waste or cast-offs from shell production, or scrap, will produce the same quantity of shipping tonnage employed in the Concrete Ship, as 3,000,000 tons of steel consumed in steel ships.

Conservation of Man Power—that is the next thought of the nation. 100,000 men building concrete ships will produce the same ship tonnage capacity as 500,000 skilled mechanics laboring on steel hulls. And with this all, we save the railroads—give them the chance to haul more coal and make more steel,—steel, the measure, the time factor of our success in France. Reinforced concrete hulls, substantial and structurally perfect cargo carriers, can be turned out to-day more quickly and in greater quantity than any other class of ship construction. Here a great auxiliary fleet can be had, obtainable through no other available means.

Give Mr. Hurley the motive power, and he can make good his promise "to build more concrete ships than Carter had oats." There is no lack of men, rigging, and material, to produce those concrete hulls. Here is the chance for the oil-engine manufacturers and factories, hitherto engaged in non-essential war work, to play a new and decisive roll in the great War and back up the line in France with all that America can do,—our maximum effort.

We have well equipped factories; we have successfully established designs, tried and not found wanting; we have foundries and machine shops in myriads engaged until now in non-essential industry and many others with their machinery even idle, all of which can now find their place in the war industry making standard parts and castings for building these established engines. The automobile industry, a stupendous resource for this very class of work, is threatened with a shut-down, confronted with the Government's recent order to get on a 100 per cent. war production basis or close. These tremendous plants can furnish no end of assistance turning to oil-engine production or rather to standardized parts for these.

The writer urged before the Senate Commerce Committee last January 26th, that engines be standardized and that quantity production of parts be carried out throughout the country in the various factories, machine shops and foundries suited to this class of work, and that assembling plants then handle the vast output coming from all points, and thereby additional motive power for a great concrete auxiliary fleet, not conflicting with the steel and wooden ship program, could be obtained.

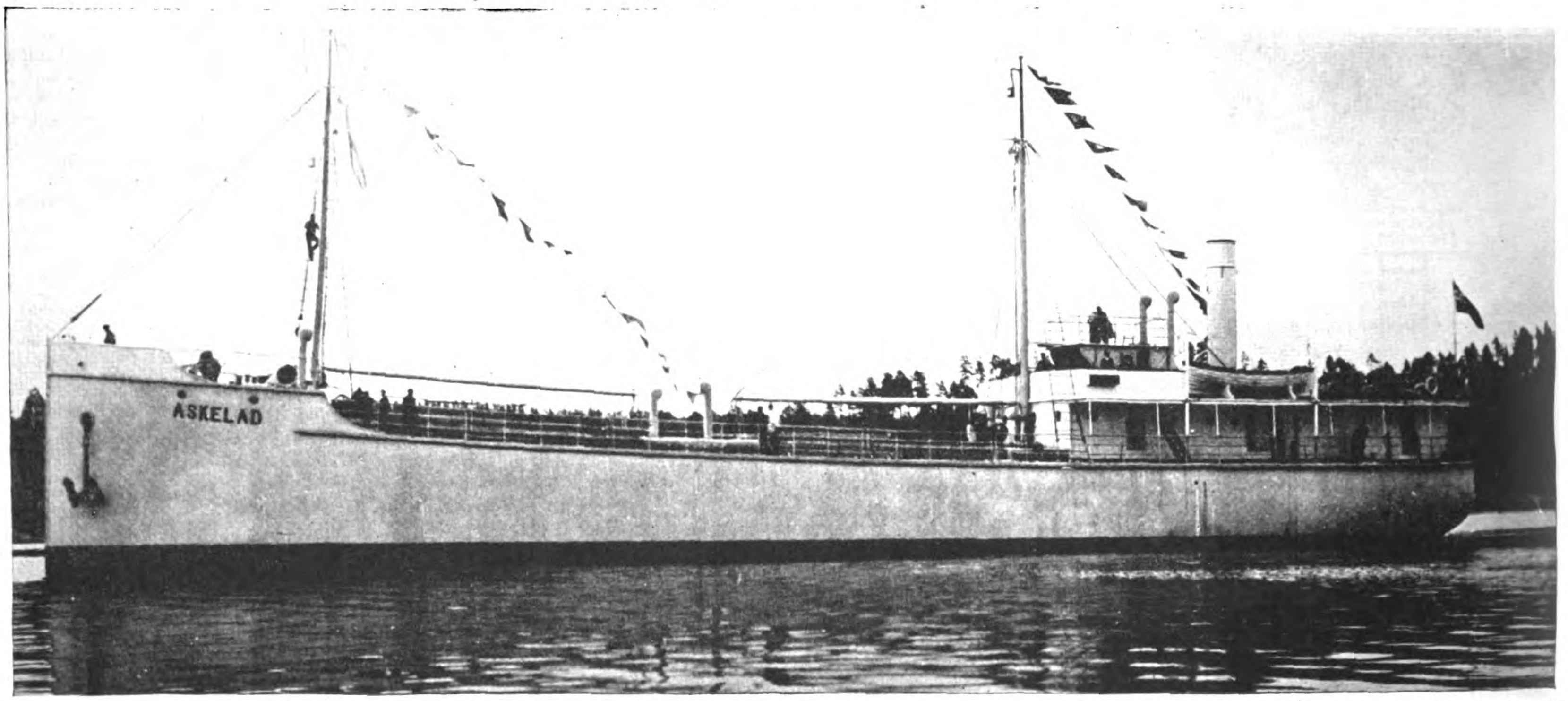
It is now gratifying to note that although this program has not as yet been resorted to by the Emergency Fleet Corporation, a private organization of engineers of distinction, backed with unlimited shop facilities, capital, skilled experience and perfected designs, comes forward in this war emergency prepared to fill this need of motive power by the very means proposed. Their letter to the writer so exactly confirms these possibilities that I quote it as follows:

"Chicago, Ill.,
Sept. 12, 1918.

"My dear Mr. Robinson:

"I have read over with a great deal of interest your letter to the Chairman of the Senate Committee on Commerce, dated May 18th. You have certainly marshalled some very strong and convincing arguments in favor of the construction of concrete ships at this time.

"In answer to your inquiry as to available power, permit me to observe that from Congressional reports and Committee hearings, statements to the press by officials of the U. S. Shipping Board, as well as newspaper interviews with vessel owners, ship builders and engineers, it appears that the country's output of steel and wooden ships is going to be largely limited to the production of steam-engines, boilers, and fittings. In fact, the production of hulls is proceeding faster than the production of power plants, it being recently stated by those in authority that we have a very considerable fleet of hulls launched and waiting for equipment.



Oil-engined concrete motorship recently built at the Fougner shipyard in Norway. S[illegible] and is propelled by two 160 b.h.p. Bolinder oil motors. America could build and equip hundreds of such vessels without interfering with war work

"If then, the country is rapidly reaching its limit in the output of completed hulls due to the limit of power plant production, how can a considerable and immediate concrete ship-building program be realized?

"Oil engines, is the answer. They require no boilers and hence a minimum of steel and only a limited equipment of valves and other fittings of which there is a pronounced shortage. And the oil-engine production capacity of the country has been scarcely touched.

"There are two types of oil-engines suitable for full-powered motor ships up to 7,500 tons dead weight carrying capacity, namely: the 'Diesel Type' and the medium compression, surface-ignition type, sometimes called 'Semi-Diesel.'

"The Shipping Board has already shown its confidence in the motorship by placing contracts for thirty-six 5,000 ton dead weight cargo vessels powered with pairs of Diesel engines of 750 brake H.P. each. Unquestionably, the possible output of engines of the Diesel type is very considerable, but it is concerning the almost unlimited production possibilities of the 'Semi-Diesel' type that I desire to draw your attention.

"Semi-Diesel engines are extremely simple and in this respect compare very favorably with the modern marine steam engine. The parts are few and simple and because of the medium compression under which they operate, their construction can be undertaken without long previous experience in the building of oil engines. But particularly, this type of engine lends itself most admirably to standardization and production on a manufacturing basis, adopting such methods of standardization and quantity production as has been utilized to such a marked degree in the automobile and stationary engine industries.

"By standardization and through the employment of elaborate jigs and specially designed ma-

chine tools, machine work can be done very largely by operators. Thus, only a very limited demand would be made on the country's supply of skilled mechanics and that principally for erecting and testing. Moreover, by the use of the above approved manufacturing methods, like parts can be manufactured at distant points and assembled and tested at a central plant or plants.

"Standardization and production along these lines have already been undertaken and have been proven wholly feasible, and I submit that power plants of the Semi-Diesel Type can be supplied for several million tons in addition to the Shipping Board's present published schedule and without interference to said schedule. Moreover, because of the simplicity of the design of these engines, production could begin immediately on an extended basis. Thus, ships powered according to this suggestion, would be available for service not only in 1920 but early in 1919.

"It is reported that a more extended building of motorships has been held up owing to the scarcity of experienced engineering crews. In this respect the Semi-Diesel Type of engine, because of its simplicity, meets the emergency most admirably: for, while it is not true that this type is "foolproof" and can be operated by ordinary mechanics and chauffeurs, it is, nevertheless, a fact that the average steam engineer or mechanic, otherwise fitted for marine service, can qualify in short order as an operator of this type of engine.

"Thus from every standpoint, the 'Semi-Diesel' meets the requirements of the emergency and in combination with concrete hulls, the building of which you have so clearly shown feasible, will add millions of tons to our war emergency fleet.

Yours very truly,

Chicago, Ill. CHARLES B. PAGE."

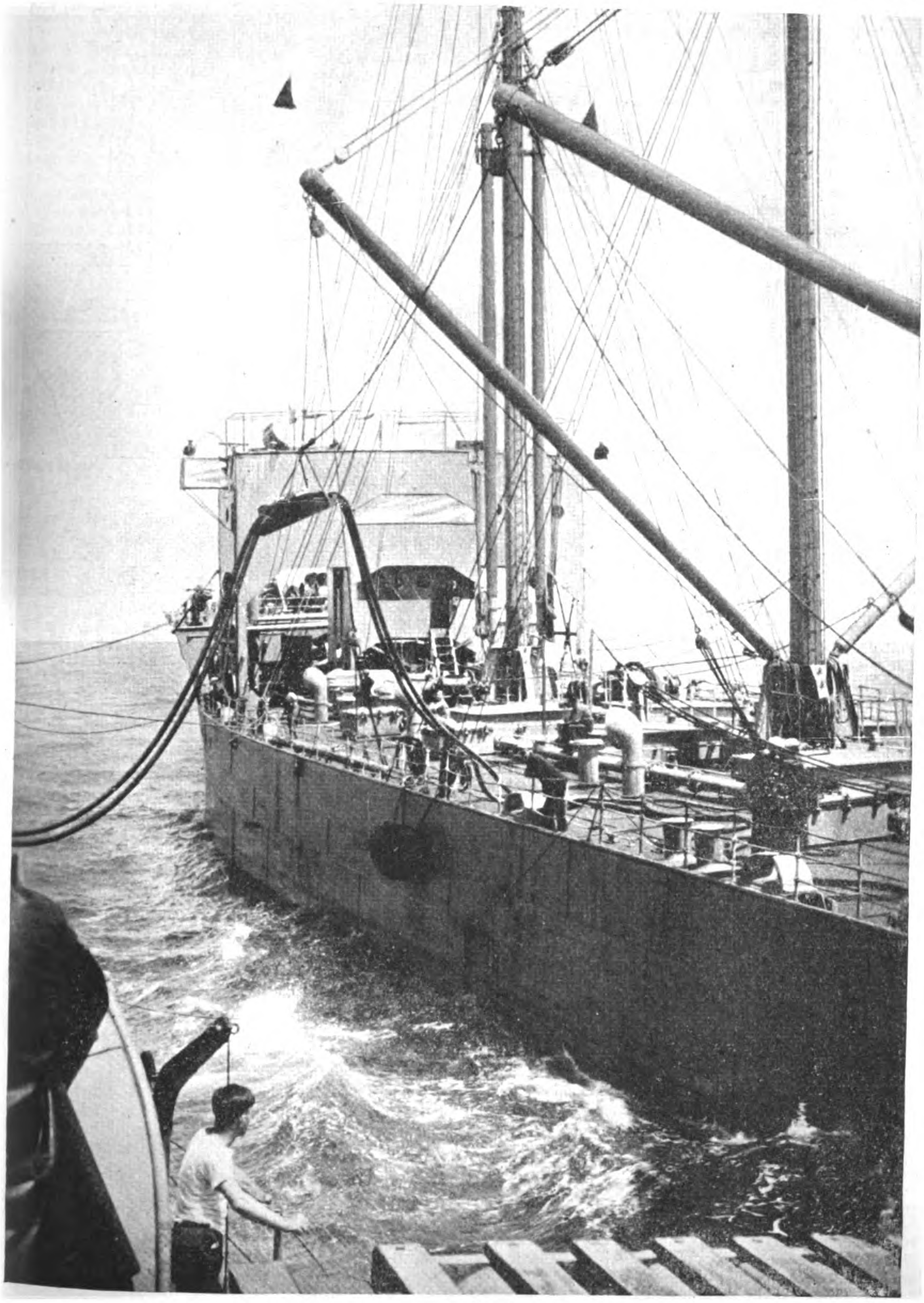
It is not necessary then to "wave the magic wand" to get "more concrete ships than Carter had oats." We can have the hulls and we can have the engines, both "Semi-Diesel" and Diesel oil-engines, to meet all demands. If the Emergency Fleet Corporation can not attempt these measures itself, let the ban be lifted against private industry building concrete ships and private capital will gladly and quickly build them at its own risk and on its own responsibility. And the oil-engine industry can serve, not only to back the lines in France, not only to make our present phantom concrete fleet a great living war fleet in full reality, but furthermore, to make this the most economically operated fleet in our American service.

Our Secretary of War has stated the case:

"There are two ways of prosecuting this war. One way is to make every possible effort to do it now, and the other is to proceed somewhat more leisurely and do it later. The obvious advantage from every standpoint, social, military, industrial and economic, is to put forth every effort in this country and win the war **as soon as possible.**"

ROY H. ROBINSON.

[According to Mr. R. J. Wig, Chief-Engineer of the Concrete Ship Division of the U. S. Emergency Fleet Corporation, the present Government programme consists of 38 tankers and freighters of 7800 tons d.w.c.; three freighters of 3500 tons d.w.c., one freighter of 3000 tons d.w.c., and 21 barges of 500 tons. There also are the motor vessels building for the U. S. War Department. Unfortunately, all the Emergency Fleet ships will be steam driven.—*Editor.*]



HOW AMERICA'S FUTURE MERCHANT-SHIPS WILL BE BUNKERED

Taking aboard fuel-oil from a tanker while proceeding out of harbor. No coal, no dirt, and no delay. Simplicity of bunkering is one of the many great advantages of motor-driven ships, and the saving in time alone will be of considerable value to shipowners, as it spells "Efficiency." A 10,000-ton motorship, instead of having to take about 1000 tons of coal at each end of a one-way voyage, will need less than 400 tons to Europe and return

CONCRETE MOTOR TUGS TO BE BUILT AT FLUSHING, L. I.

Several motor-driven concrete tugs have been ordered from the Fougner Concrete Shipbuilding Company of New York and will be built at their ship-yard at Flushing Bay, Long Island, New York.

MOTORSHIP STRIKES WRECK

The British motorship "Mount Carmel" says a Lloyd message, is reported to have sunk after striking a submerged wreck. This vessel is not on our records so presumably she is one of the new motor vessels constructed in Great Britain during the war.

AUXILIARY SHIPS IN THE SOUTH

At the Pensacola and Milton (Florida) shipbuilding yards of the Bullock-Caldwell Shipbuilding Company, two 1,800-ton auxiliary-schooners are reported to be under construction, in addition to the 1,800-ton auxiliary-schoner at the Coyle shipyard. There also are building some 800-ton sailing-ships.

IRON SAILING-SHIP FITTED WITH MOTOR POWER

"Merioneth," an old iron sailing-ship of 1,395 tons gross, built for Sir Thos. Royden of Liverpool in 1875, has been fitted with a four-cylinder 13¾ in. bore by 19 11/16 in. stroke, Ansaldo-Savoia Diesel engine. The "Merioneth" is 231 ft. long, 23½ ft. depth, and now is owned by Quagha & Goldinini, an Italian shipping concern.

THE DIESEL-DRIVEN AUXILIARY "THURO"

During the war there has been in regular operation between Denmark and Great Britain the motor-auxiliary sailing-ship "Thuro," owned by the Phoenix Shipowning Co., Ltd. This vessel is fitted with a Holeby-Diesel heavy-oil engine of the four-cycle type. The new six-cylinder 400 b.h.p. Holeby marine Diesel engine is of the crosshead class and is directly reversible.

CANADIAN MOTORSHIP FOR AUSTRALIA

Recently there arrived in Australia the 800-ton motor-auxiliary schooner "Abomana," built for Peter Yee Wing & Co., of Sydney, Australia, by the Nova Scotia Shipbuilding & Transportation Company, of Liverpool, Nova Scotia, Canada. She made a very successful voyage. This Canadian company also recently launched a 900-ton motor-auxiliary schooner named "James G. Jay" to the order of Job Bros., of New York and St. John, Newfoundland.

MOTORS FOR HOISTING SAILS

There are under construction quite a number of sailing vessels in Canada and the United States and in nearly all cases where an auxiliary propelling oil-engine is not installed there is fitted on deck a gasoline motor varying from 8 to 20 h.p. for the purpose of hoisting the sails, raising the anchor, handling cargo, pumping, etc. Among such vessels recently built may be mentioned the schooner "William Duff," built by the Earnst Shipbuilding Company, Mahone Bay, Nova Scotia, and the three-masted schooner "Barbara," a vessel of 363 tons gross, built by G. Gulliford, of Brentano, Newfoundland. This latter vessel has a gasoline motor of 8 b.h.p.

Oil-Engine Sprayers or Pulverizers

No. 4

(Continued from the September issue)

By A. H. GOLDINGHAM and C. T. O'BRIEN

THE numerous different designs of sprayers which have been illustrated, described or referred to in our previous articles is without doubt evidence of the great amount of time which has been devoted in all the countries where Diesel engines are built to the design of this apparatus and goes to prove how important is its function in the successful operation of Diesel or other oil engines. Reference has already been made in the second installment to the ideal requirements of the sprayer or pulverizer and the form the spray should take on entering the combustion space. In a paper read before the Diesel Engine-Users Association of England recently, Mr. P. H. Smith pointed out two essential conditions for burning tar-oils in Diesel engines, which cannot be dissociated if satisfactory operation is to be achieved with refractory fuel oils. He referred to (a) atomization and (b) turbulence. The former term refers to the degree of fineness of the spray at the moment it leaves the flame plate or nozzle,

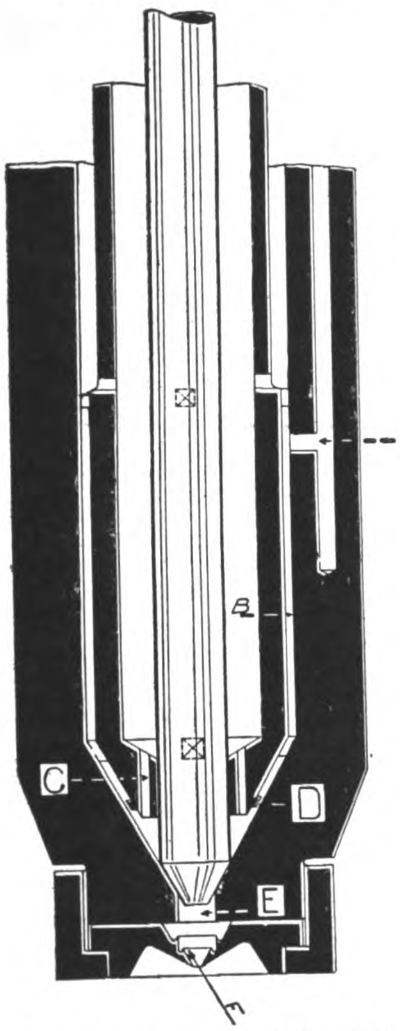


Fig. 41—Injection-valve for using tar-oil

while the latter designation refers to the degree of "swirling" which occurs in the combustion space as the spray enters it.

"Turbulence" produces a commotion or agitation which results in a more or less intimate mixture of the fuel and air which varies as the turbulence is more or less vigorous. Efficient atomization, but without vigorous turbulence, has these disadvantages.

1. The safe full load or maximum rating of the engine must be reduced.
2. The thermal efficiency at full load or overloads is reduced.
3. The operation of the engine is limited to the use of higher grade refractory fuel oils.

Efficient atomization and slight turbulence with light loads is advantageous, as the mixture otherwise may be too dilute to burn. With inefficient atomization combined with vigorous turbulence at light loads, then "knocking" may result and also misfires may take place. He further pointed out that the ordinary pulverizer has deficient atomization, but has ideal turbulence, and he attributed this to the spray being decidedly wet as it leaves the nozzle or flame plate due to the coalescence which occurs between the top of the valve cone and the aperture of the nozzle. During the passage of the fuel through the rings a perfect spray is probably created, but on entering the flutes of the cone of the standard pulverizer, coalescence occurs and then the fuel settles into regular stream lines, which state is maintained as it pasess between the valve and its seat which results in a very "wet" spray.

This condition he claimed is very deficient for burning tar oils at light loads. The condition of turbulence with the standard fuel valve is excellent as the spray passing through the centre of gravity of the combustion space at high velocity impinges on the concaved piston head and is spread equally around. He also claimed that the importance of turbulence at heavy loads is evidenced by the fact that a M.E.P. of 150 lbs. can be obtained with perfect exhaust with the standard pulverizer notwithstanding its imperfect atomizing properties. A perfect spray is obtained with at least two known systems.

(a) The solid-injection (without compressed-air) system, when the spray is found so finely divided that it scarcely moistens or discolors an object passed through it.

(b) Those pulverizers in which a "whirling" effect is produced.

Both of these types, however, it is claimed, are deficient because "turbulence" is absent in the former and inadequate in the latter. With the solid-injection type a hydraulic pressure of 4,000 to 5,000 lbs. is created.

As regards "dryness" of the spray, the following systems of sprayers were classed in the following order of merit by Mr. Smith:

1. Solid injection.
2. Whirling spray.
3. Sharp-edged orifice.
4. Rounded orifice.

As regards their merit for turbulence, they were also classified as follows:

1. Sharp-edged orifice.
2. Rounded orifice.
3. Whirling spray.
4. Solid injection.

To overcome the shortcomings of the various sprayers as at present constructed for operating with tar oils at all loads, a special sprayer has been constructed in which the fuel is pulverized at a point closer to the combustion space than is usual and then violent turbulence is introduced at the valve point. The subsequent coalescence at the flame plate or nozzle is so treated that the particles of liquid fuel are thoroughly reconverted into a spray. Thus such spray when passing into the cylinder is remarkably dry and homogeneous, consequently the engine operates at light load satisfactorily without in any way sacrificing the heavy load advantages.

This type of pulverizer is shown in the diammgrammatic illustration of Fig. 41, in which the entrance of the fuel is shown at A—it then settles around the outside of the sleeve B, where it is subject to the maximum blast pressure. When the valve is raised from its seat and opens, the fuel is forced past the restriction shown at D and reduced thereby to a film form. The compressed air impinges on this film of oil with violence as it issues from the passages shown at C. By this action the film of oil is reduced to spray form, but coalescence takes place in the passage shown at E, but again these liquid particles are then forced into the grooves at F, and are thus again completely disentegrated.

Diesel engines are said to be running on gas tar at a factory in Germany. According to "The Engineer," the tar is heated to 30 or 35 degrees Cent. by hot water from the cylinder jackets, and is passed through a gravel filter about 16 inches thick, under a head of 4 metres. After filtering the tar is heated by the exhaust gases and arrives at the fuel pumps with a temperature of 70 to 80 degrees Cent. Complete combustion is obtained, while the filter only requires attending to once a month.

In addition to the many designs of crude mineral oil sprayers illustrated in our previous articles on this subject, the three following well-known makers' designs of pulverizers are of great interest. Fig. 42 shows a partial view of the Werkspoor sprayer as manufactured by this eminent firm in Amsterdam, Holland, and as now being built in America for the U. S. Government. As is well known, their engine has achieved as great a success as any other the world over for marine purposes, and one of the features which has gone to achieve this pre-eminence is its extreme fuel economy, which again has been due largely to the thorough pulverizing of the fuel in the combustion space. This illustration is made largely from a sketch of a sprayer in actual operation. The spray-valve body marked A and the flange B which fits into it are both held in place on the cylinder cover by the bolts as shown. The distance piece C inserted into the body is held in place by means of the lugs shown at the upper and lower ends of the valve. The atomizer D is attached to the tube by a thread as shown. The stuffing box is indicated by E. This also acts as a guide for the valve stem F. In operation the fuel enters through the passage G and meets the high-pressure air which is introduced through H at the atomizer at the lower end of the sprayer. A counterflow

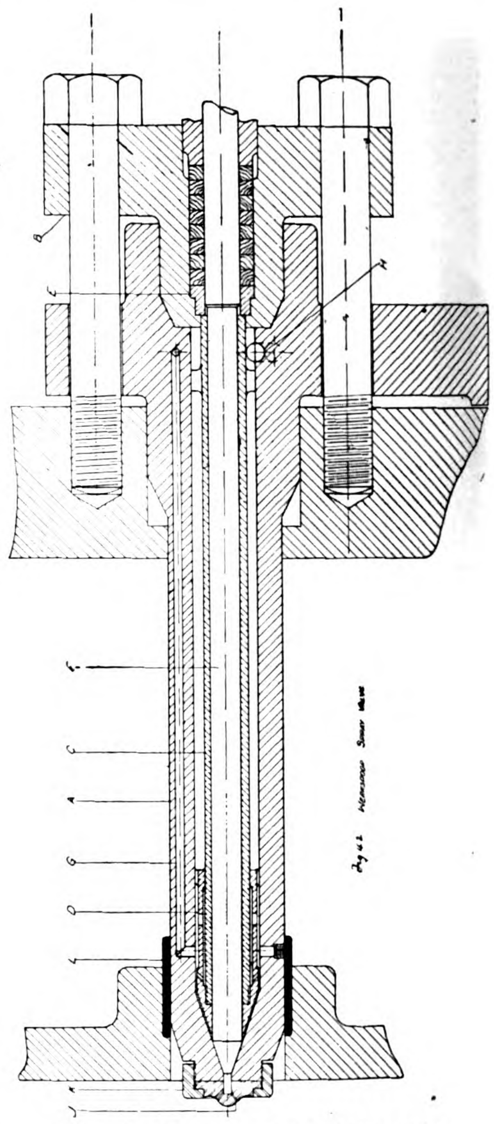


Fig. 42—Werkspoor fuel-injection valve

action then takes place which results in a thorough and intimate mixture of the fuel and air. At the proper period the valve is raised from its seat and the spray is injected into the combustion space through the radical holes in the nozzle J, evenly distributing the spray around the whole combustion chamber.

The steel tube shown at L is employed as a guide for the spray valve and is inserted in the lower wall of the cylinder head. While simple in design, it obviously is efficient.

The Craig sprayer or pulverizer shown at Fig. 43 is one of the few of these devices which has been entirely designed and developed to a very successful state of efficiency in this country. It is built by the James Craig Engine Works, Jersey City, N. J. Mr. Craig went to Europe about six years ago and made a thorough study of the leading European practices, and then produced a design himself. Referring to the illustration, it will be seen that the sprayer body A contains the guide tube E which is maintained in place by the projection G which acts as a guide and holds the spring H in

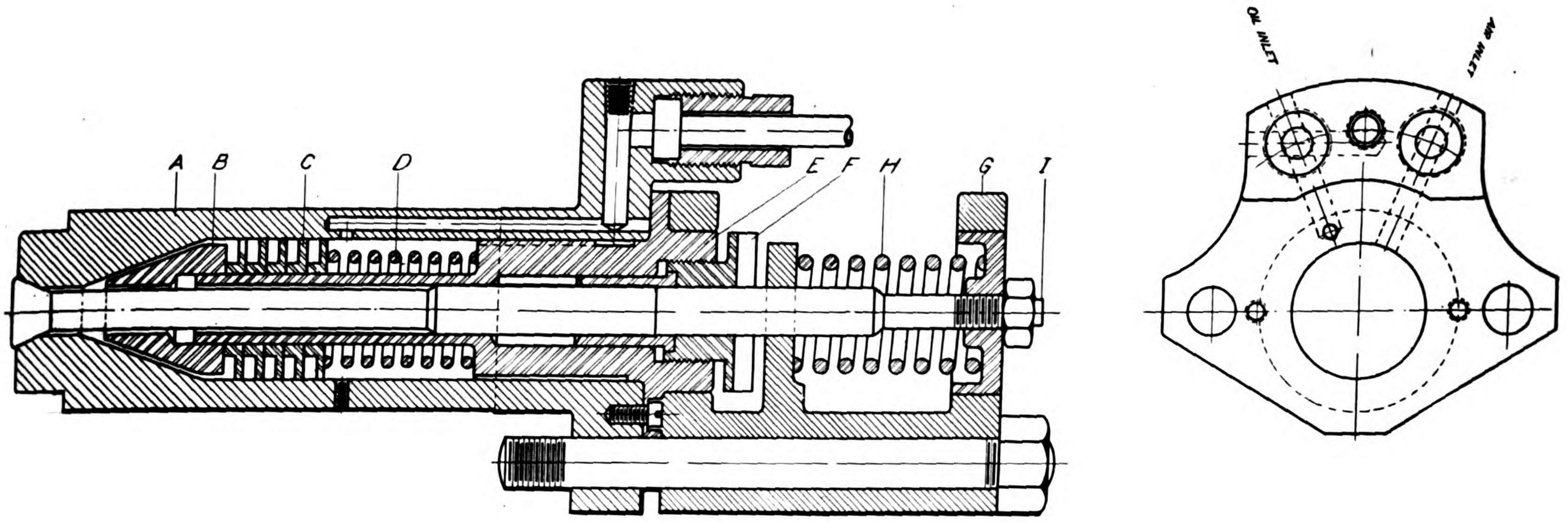


Fig. 43—The Craig spray valve

place. The atomizer is composed of five perforated plates marked C through which the fuel and compressed air is forced. These plates are placed around the tube E, and are held in place against the stop B by means of the spring D. The stuffing box F is inserted into the tube E, as shown. The valve stem, it will be noted, opens outward, and its lower end is cone-shaped, so as to thoroughly distribute the fuel evenly all around in the combustion space. The passages for the oil and compressed air inlet are shown on the illustration above the sectional view.

In Fig. 44 is shown the pulverizer as built by the pioneer Dieesl-engine builders of the U. S., the Busch-Sulzer Bros. Diesel Engine Co. of St. Louis, Mo., originally the American Diesel Engine Co.

The fuel-distributor H is of the plate type. It consists of a series of plates evenly spaced on a sleeve. The outer circumference of the plates fit snugly into the bore of the valve cage. Each plate is perforated by a number of small holes located on a circle of smaller and larger diameter on alternate plates. The plates and distance rings are held on the sleeve B by a cone-shaped nut, grooved on the surface seating against the cage. These grooves are either straight or spiral, and converge towards the fuel needle seat proper.

Before the fuel valve D opens to admit fuel to the cylinder, the fuel is deposited by the pump in an annular chamber E and overflows through an annular slot F on the top plate and through the small holes on the plates below. When the needle-valve opens, the air sweeping over the plates and through the holes gradually carries the fuel along. The advantage of this type of distributor lies in

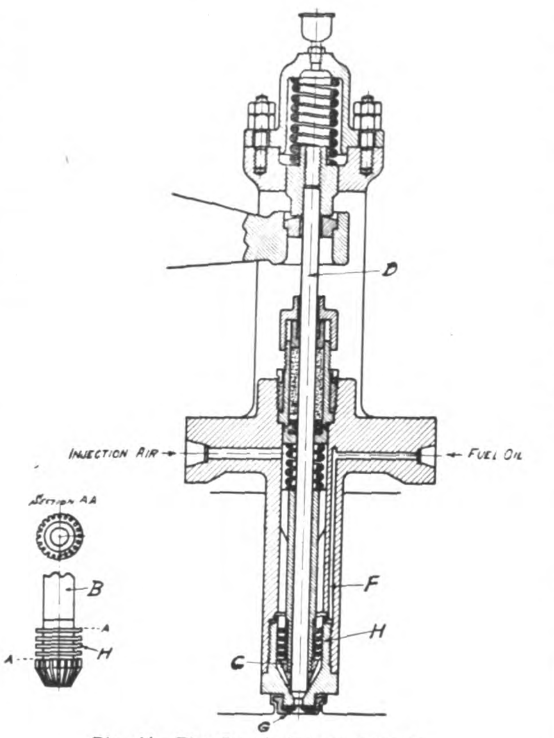


Fig. 44—The Busch-Sulzer injector

the facility with which the distribution may be changed to suit different fuels by changing the number of plates or the size or number of holes in the plates.

The fuel-atomizer or sprayer G consists of a nozzle with one opening. Through this opening the mixture of fuel and air reaches its maximum velocity, possibly 250 to 350 feet per second. This high velocity is regarded as essential to good atomizing of the fuel. The process of pulverizing the fuel is better understood if we realize that the particles of oil have a certain mass and weight, which cannot be accelerated suddenly, and that they move relatively slower than the air jet which passes by them and which tears up the oil particles into a great number of very fine globules. This jet of finely divided fuel and air entering the combustion space stirs up and creates eddies in the compressed combustion-air, aiding the flame propagation and making use of all the air present for combustion purposes.

FINIS

A sea-going motor tug fitted with a Union distillate-fuel engine and used for towing spruce logs at Astoria

Faults in the Design of Some Surface-Ignition Oil Engines

An Operator's Idea of an Improved Motor

By W. J. WOODCOCK

THE writer has been a construction-engineer and contractor as well as an operating-engineer for many years and is a firm believer in the heavy-oil engine as a motive power for ocean-going vessels, notwithstanding the fact that there has been a great deal of trouble with at least some installations. It is not uncommon to read a statement that the fault is due to marine engineers who have not had sufficient training to operate them. My experience in the engine-rooms of ships at sea with various types of engines, convinces me that this is not entirely so, because I have seen enclosed crankpin boxes melted-out when the guarantee-engineer from the engine-builders works was present.

I do not see how engineers can be trained to take care of bearings that can not be seen or felt, or held responsible for them, and I do not believe that this condition is practical for ocean-going vessels which require reliable power.

On the other hand I have seen two-cycle engines of the Bessemer type that compress the scavenging air in a chest on the side of the cylinder instead of in the crank-case, which system leaves the bearings open, so that they can be taken care of as is the case with an ordinary steam-engine. I was told by the owner of such an engine that it had run for three years and never lost any time or hadn't had a cent spent on it for repairs—and the engineer was not a specially trained man. This engine, however, was of the stationary type in service on land; but, there is no reason why the principal should not be applied to marine engines and give the engineer a chance.

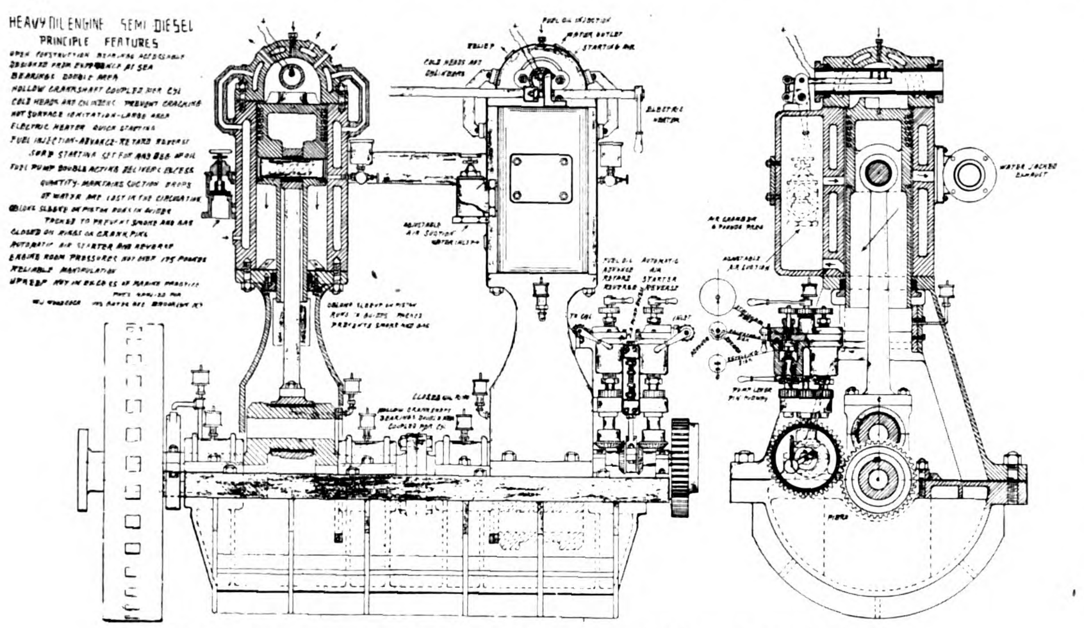
Many marine heavy-oil engines have enclosed crankpins and same include the main bearings. It is well to compare the area of those bearings with a marine steam-engine doing the same work, which are always of open design.

One day we lay alongside of a cargo vessel which had a quadruple expansion engine using 250 lbs. steam pressure. She had a 15" high-pressure cylinder and a 11" crankpin and turned up about 100R.P.M. The engine of our vessel had an explosion—pressure of about 280 lbs. 14" cylinders, with 6" crankpins and turned over 200 R.P.M. and was totally enclosed. Now is it reasonable to expect the same reliability from the heavy-oil engine, although the service requires it, and the owner expects it, and will any amount of training that can be given to engineers make up for the difference between the two installations?

Given the same bearing area in proportion and the same open construction, any steam engineer can beat the steam-engine with a heavy-oil engine on every point, and will prefer it; but no one knows what it means to take out those enclosed hot crankpin boxes and main bearings when the vessel is uneasy—except those who have had to do it. Some of those engines have crankpins without area enough to let the propeller turn without running the brasses hot.

The atmosphere in the engine-room on many surface-ignition engined motor-vessels is much worse than in a steamship. This is entirely unnecessary and the remedy should not be by resorting to exhaust fans and extra equipment for ventilation; but by differently designed engines.

A reliable engine can be made for ocean service using the two cycle Bessemer-type with surface-ignition injection, with no engine-room air service pressures over 200 pounds per square inch. Open construction bearings of such an area which will compare with good marine steam practice should be adopted, taking the initial pressures as a basis for computation, because it is this initial pressure which drives the oil out between the surfaces of the crankpin and its boxes. The first movement is metal on metal and trouble starts right there. A piston-rod and crosshead would be used, or a piston constructed so it could be packed, that smoke or gas could not escape into the engine room, and the ignition surface should be electrically heated instead of by a blow torch of some kind as is now used, which makes a bad atmosphere. Then the engine-room conditions would be better than in a steam installation and the bearings could and would be taken care of and give the required service by any marine engineer. When trouble is experienced with motorship installations it usually is with the bearings.



Mr. Woodcock's idea of an accessible surface-ignition marine oil engine

I have never seen any serious difficulty in handling the fuel, but believe that an **advance** and **retard** system of injection of the fuel would be an improvement, for the same reason that it is used on gasoline engines, and also for using heavy-oil of different densities. The firing point for 24 deg. Baume oil-fuel would hardly be right for kerosene. Water injection could be eliminated and the advance and retard movement should be carried far enough to reverse the engine if running without using the air-pressure. If a fuel-pump of excess capacity be used and the surplus returned to the suction through a pressure-valve admitting the fuel to the cylinder by means of a disk under pressure, a full charge will be delivered to the cylinder each stroke, active circulation will eliminate the sensitiveness of the fuel-pump, and small amounts of water contained in all fuel-oil in bulk will be lost in the circulation, instead of killing the engine, such as when the fuel-pump delivers only its capacity into the cylinder.

An automatic air starter and reverse mechanism requiring not over 200 lbs. air pressure and made exactly as the disk for fuel-oil injection, except that the slot is longer, adds greatly to reliable manipulation and almost entirely eliminates "jacking over," even in a two-cylinder engine, because on account of compression in the cylinder the engine rarely stops exactly on the dead center and therefore is easy to handle and the engine can be started with the load eliminating clutches.

The accompanying illustration of an engine that I have designed from my experience requires but little explanation. The heads are cold and not liable to crack and do away with considerable heat. The ignition surface consists of a pipe running through the combustion chamber, and, as the pressure is on the outside it can be quite thin and quickly heated by electricity from the inside. The electrical device therefore is always exposed to the air. Fuel-oil is injected on this hot surface and the current cut off as soon as the engine is started, so no smoke or gas results from this method of heating.

While the engine can be and has been constructed with a piston rod and crosshead, a longer connecting rod can be used, and several parts eliminated by attaching an oblong or oval sleeve to the piston and which runs in guides and packed (similar to a steam hammer) for the connection rod to work in. Such construction adds but very little to the height of the engine over the crank-case compression type. Air circulates through this sleeve to the piston head and carries away heat as does also the air which passes through the open pipe forming the ignition surface which passes through the combustion chamber. The ignition surface is of considerable area due to its form so insures good firing, and on account of its arrangement the scavenging of the cylinder is excellent.

The fuel-oil and air distribution is very simple, preferably a revolving disk for each cylinder and the supply under pressure. An adjustable disk with a groove on the side in contact with the stationary head allows for the advance and retard. When the oil ports are in line and the crank is on top center it is evident that oil is taken the same on each side of the crank center and when the adjustable disk is advanced or retarded, the oil is taken in on either side of the crank center. If the adjustable disk is moved far enough the engine will reverse.

It is certainly better to couple the crankshaft between cylinders same as is done on steamships. It is an easy matter to get out a section without laying up the vesel for a considerable period, and if made hollow it gives the necessary large bearing area without adding materially to its weight and it will not hold the heat as long.

A closed oil ring on the crank pin can not be objectionable and grease can be forced in the bearings if desirable, cutting down on oil. A full A frame that has been used so extensively on steam engines makes a clean strong engine with all bearings accessible. The air suction that is adjustable has given the best results on engines that I have operated, and very little smoke or gas gets past it into the engine-room.

The engine should not be fitted too tight. Fine and mysterious points should be eliminated and any marine engines will give reliable service and the upkeep will not be excessive, while the first cost is comparatively low. Perhaps it is well to mention that patents have been applied for on some of the features of the engine illustrated.

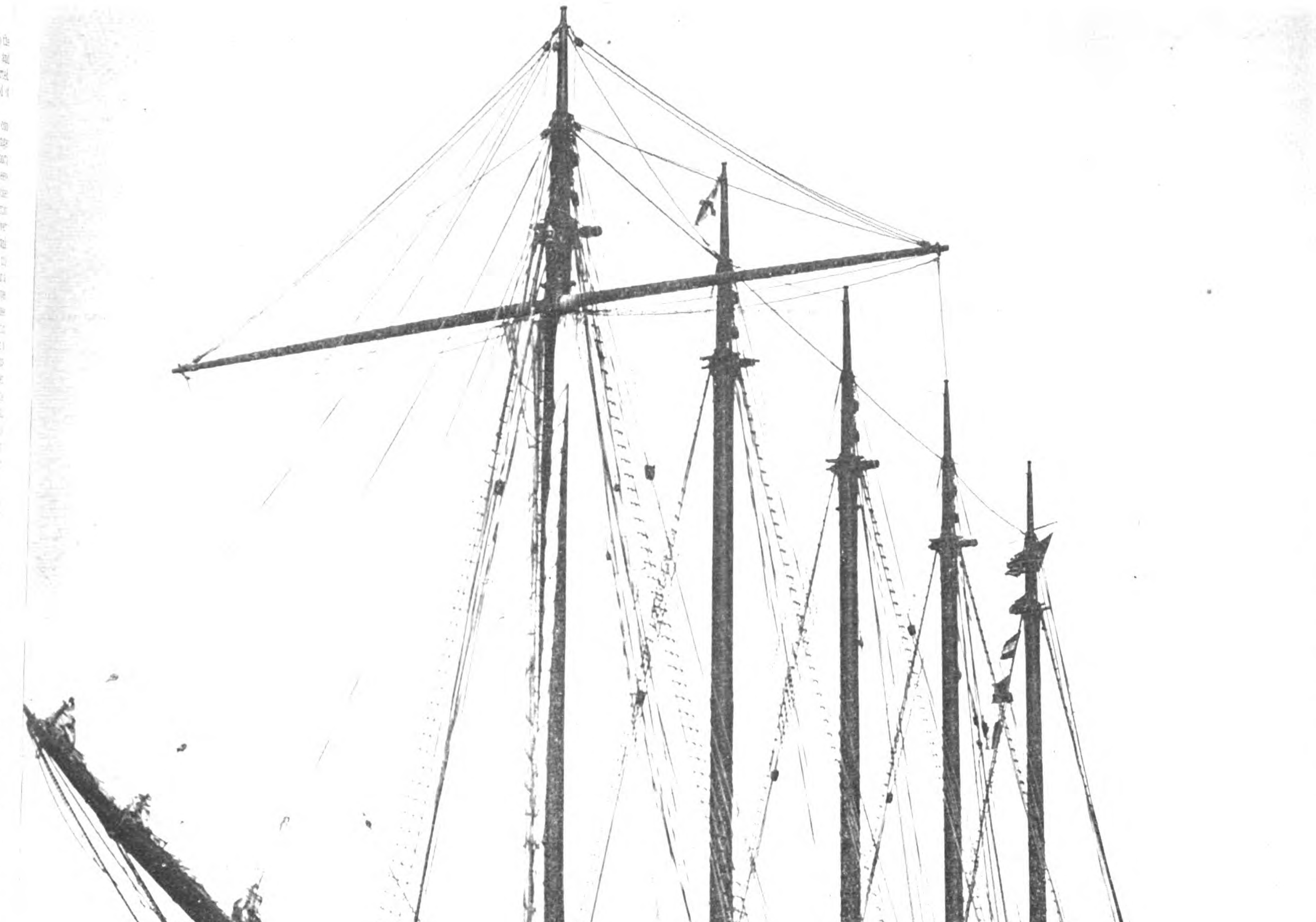
Launching of the "Solgull"

"SOLGULL," A SPANISH MOTOR AUXILIARY

Of late a number of references have been made to motorships, motor-auxiliary sailing ships, and motor-driven naval vessels, under construction in Spain, and on this page we give an illustration of the launching of the three-masted motor-auxiliary schooner "Solgull" at the yard of Minguel é Hijos (Minguel & Son), Barcelona. This vessel has the following dimensions:

Length	108' 0"
Breadth	22' 9"
Depth	12' 6"
Tonnage	250 d.w.c.

With the exception of the oil-engine, which was imported, all the materials for this ship were manufactured in Spain. Judging by the large crowd present at the launching, the event evidently was considered locally to be one of importance. Other motor auxiliary schooners are under construction at this yard.



SUCCESSFUL MOTOR-AUXILIARY SAILING SHIPS (No. 1)

The "CITY OF ST. HELENS." Although this vessel and her sister ships are a little under-powered, their operations demonstrate that a well-designed, strongly built and properly powered, oil-engined sailing-ship is a successful commercial investment. She can carry over 3000 tons of cargo in addition to fuel, and one of her voyages was a distance of 17,600 miles in 108 days, with absolutely no repairs. So surely every American sailing-ship should be fitted with an auxiliary motor. The "CITY OF ST. HELENS" was built by the St. Helens Shipbuilding Co. for Chas. R. McCormick Co., and is propelled by two 320 b.h.p. Bolinder reversible heavy-oil engines.

Four Thousand Miles Voyage of the M.S. "Libby Maine"

Non-stop Run from Seattle, Wash., to Bristol Bay, Alaska, and Return, of a New Diesel-Engined Freighter

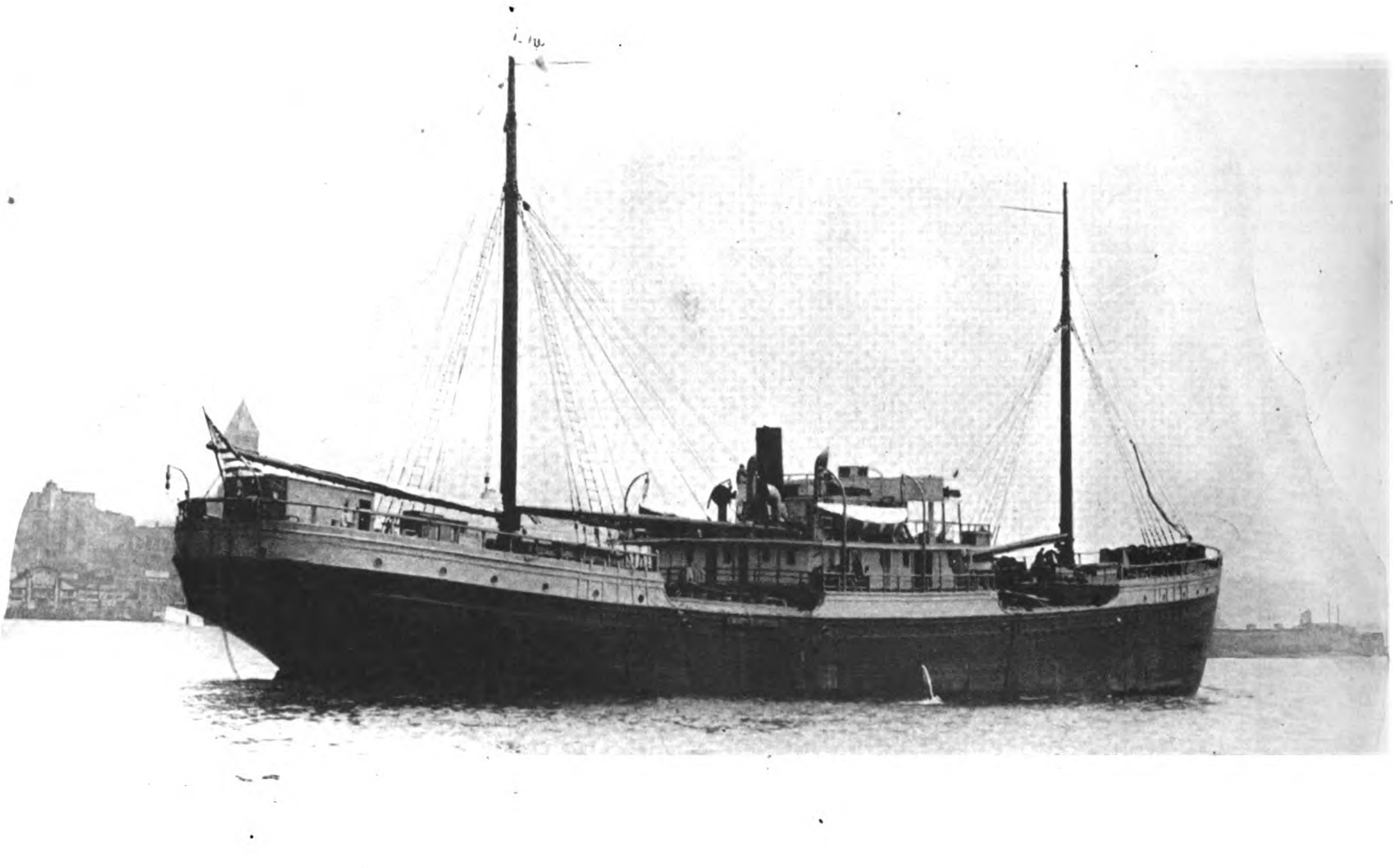
JUST as there is a silver lining to every cloud, there is not a little amount of satisfaction to be extracted by oil-engine builders from the fact that today the U. S. Government is handling the operation of the shipping of this country, also some of the shipping of foreign countries, because the officials who mostly are devoted to steam power are becoming familiar with the splendid voyages regularly made—not only by large European Diesel-driven merchant motorships, but by smaller American-built motor freighters. These performances are leaving impressions that cannot be treated lightly, especially as the said impressions are most favorable. In one or two instances the officials handling the sailings, etc., lately have become strong advocates of oil-engined cargo vessels, and we only hope that they will make reports and strong recommendations to the head officials of the United States Emergency Fleet Corporation.

Details of the excellent voyage just completed by the new full-powered motorship "Libby Maine" doubtless will be of particular interest to ship-owners and builders, especially as it is the first Maine" to be an excellent cargo boat, and has demonstrated that American Diesel engines are thoroughly reliable and satisfactory in marine service.

No effort was made to set a speed record, as the vessel was not built for speed, and Mr. D. W. Branch, manager of the canned salmon department of Libby, McNeill & Libby, under whose supervision she operates, wisely had given orders to hold the engines somewhat below their rated number of revolutions during the first voyage, until any stiffness might be worn off.

The outward voyage started at 6:30 P. M., June 30, the vessel carrying some 2,000 tons of cannery supplies, and having a draft of 17 ft. 3 in. forward, 21 ft. 3 in. aft, or 19 ft. 6 in. mean. Making an average speed down the sound of 6.6 knots at 220 r.p.m., she came abreast of Cape Flattery at 10:55 A. M., July 1, and set her course for Unimak Pass. For several days thereafter she encountered a heavy northwest head wind and sea, which for a time held her down to 4 knots, with the engines turning 224 r.p.m.; but later increasing the engine speed to 234 r.p.m., she made 7 to 8 knots under favorable conditions this would have been a difficult bit of work, as it was necessary to traverse the anchorage, where some 20 vessels were lying in a limited area, and work up a tortuous channel among sand bars. To complicate matters, on August 11, when the trip was made, there was a heavy wind and sea, combined with one of the rushing ebb tides characteristic of the region. To bring the "Libby Maine" safely alongside the steamer therefore required close calculation and delicate handling, with instant and unfailing response by the engines. The feat was successfully accomplished in two hours after leaving the anchorage, during which time the first assistant engineer, who alone handled both engines, responded to over a hundred bells from the bridge without an error, bringing her into position easily and without trouble of any kind.

Ease and accuracy of manipulation are, in fact, a most striking feature of this installation. The impression has been rather prevalent among some owners that a motorship requires the assistance of a tow-boat in docking or maneuvering in close



The new American motorship "Libby Maine" which has made a very successful voyage

Dow-Diesel marine installation. The "Libby Maine,' whose maiden trip from Portland to Seattle was described in our August issue, returned to Seattle on the evening of September 4th, after a non-stop voyage of 2067 miles each way, having made the trip out in less than 13 days, and back in 12 days. The engines gave no trouble of any kind, and no stops were made. We understand that a source of particular satisfaction to the engineers is the ease with which they were manipulated under the difficult navigating conditions of Bristol Bay, where heavy tides and treacherous shoals make constant and quickly responsive control of power a necessity; and a most interesting feature of the trip was the fact that both 320 b.h.p. engines were handled at all times and under all circumstances by a one-man control. Although under the circumstances the results were excellent, we think it best to again mention that we consider the "Libby Maine" underpowered, which, of course, is no fault of the engine builders.

The voyage, on the whole, has shown the "Libby slightly varying weather conditions. On July 11, at 11:22 A. M., she went through Unimak Pass into Behring Sea, having traveled 1597 miles; and at 1:20 P. M., July 13, dropped anchor off Libbyville, in Bristol Bay, completing the outward voyage of 2067 miles in 12 days and 21 hours actual running time from Seattle.

On August 10 a trip was made from her anchorage to the Libby cannery, in the Nushagak River, to discharge coal and take on canned salmon. This trip was uneventful, the only matter of interest being that Capt. Herre, master of the vessel, took her up the channel of the Nushagak under her own power and without a pilot, being already convinced that the engines could be depended on for the navigation of those rather ticklish waters.

The most hazardous part of the entire trip, and that which most fully brought out the quick responsiveness and flexibility of the engines under difficult conditions was to go alongside the steamer "Curacao" for the purpose of transferring cargo and crew from the Ekuk cannery. Under most quarters; but the "Libby Maine" has not used a tow-boat since leaving the drydock at St. John's, Oregon. She was easily handled under her own power along the Portland waterfront and down the Columbia, and made six landings in a stiff tide at Seattle before leaving for Alaska, besides many since her return, in addition to the successful navigation of the Naknek and Nushagak. No accident or trouble of any kind has occurred in any of these movements, in which she has been found to handle more readily than a steam vessel. In maneuvering in Bristol Bay, the first assistant repeatedly reversed the engines in 5 to 6 seconds, and similar rapidity of action was attained in docking at Seattle.

This quickness in reversing is due to the simplicity of the lever movement, the reversing being governed entirely by one small handle for each engine, conveniently located for one-man control, which is moved forward for "ahead" and back for "astern." Safety as well as ease of manipulation is assured by the interlocking devices of the con-

trol mechanism, which makes it impossible to throw on the starting-air when the engine is running in either direction, or to reverse the mechanism while the engine is running, or to start the engine until the lever has moved through all positions from "ahead" to "astern," and automatically cuts off both fuel-oil and injection-air when in the "stop" position.

The "Libby Maine" remained alongside the "Curacao" overnight, transferring cargo, and a few days later went through a similar performance, going alongside the steamer "Admiral Watson" in a strong tide, with a moderate sea, to transfer a cannery crew.

For her return trip the "Libby Maine" loaded a full cargo of canned salmon below decks, with a heavy deckload of salt salmon, giving her a deadweight cargo of about 3000 tons, besides carrying some 200 cannery hands in addition to her cabin passengers and regular crew. Thus heavily loaded she had, when starting for Seattle at 5:15 P. M., August 23, a draft of 22 ft. 9 in. aft and 22 ft. 6 in. forward. Starting the engines at 225 r.p.m., she averaged about 5½ knots at the start, but increased the speed during the next two days to 240 r.p.m., averaging 7½ knots. Yet her total propelling power is but 640 b.h.p., or considerably less than a steamer of her carrying capacity would have. She came through Unimak Pass August 25, and for several days thereafter had a rather heavy wind and sea abeam. At this time, as well as in bucking the head seas on the trip up, the vessel behaved very well and rode the seas in good shape, the engine performance being unaffected in any way. Cape Flattery was brought abeam at 3:38 A. M., September 4, and at 10:55 that evening she tied up at the dock in Seattle. After discharging, she left for the Libby pineapple canneries in the Hawaiian Islands, whence she will return to San Francisco.

The average fuel-consumption for the trip was 0.41 lbs. of fuel-oil per brake-horsepower per hour. The average daily consumption of lubricating oil per 24 hrs. for the main engines was about 13 gallons.

Several features of the engines' performance gave particular satisfaction to the engineers and captain, one of them being the low engine-room temperature, which averaged 75 degrees, and never exceeded 83, making matters comfortable for the operators. With a sea temperature averaging 60 degrees, that of the cooling-water around the cylinder-heads averaged 90 degrees. We understand that absence of noise and vibration was also a notable feature. A person standing on deck or in the staterooms would scarcely know that the engines were running, and the only noise of the exhaust audible to a person standing on the bridge beside the stack was a slight hissing. Another matter which has occasioned some comment was the complete absence of smoke or visible vapors in the exhaust. This condition was maintained throughout the trip, and no sign of carbon, soot, or dirt from the exhaust was visible on the bridge or upper deck at any time.

Capt. Herre, master of the vessel, who until he took charge of her was a little prejudiced against Diesel engines, says he was surprised at the quickness and accuracy with which they unfailingly responded. He feels that on this voyage, particularly on the run into the Naknek River, they were given a very thorough test and made good in every way, and is willing to rely on them under any conditions that may arise. Obviously this particular marine Diesel engine has come to stay, and while the greater part of the capacity of the Dow shops for the present is occupied with Government work of other classes, further installations may be looked for in the not distant future. Here it may be mentioned that this is the fifth important Diesel engine plant in this country, whose valuable experiences and output have been turned over to other classes of engineering work by the authorities. It is our opinion that such is a regrettable error, and the situation should be rectified as quickly as possible. The other four plants whose capacities should be devoted solely to merchant-ship Diesel oil-engines are: The Snow-Holly works of the Worthington Pump & Machine Co., Buffalo, N. Y.; the Nordberg Manufacturing Co., Milwaukee, Wis.; the De La Vergne Machine Works, and the Midwest Engine Co., Indianapolis, Ind. Thus the Diesel experiences of these firms are wasted.

General Notes and News

4000 TON WOODEN SHIP CONSTRUCTED IN 17½ DAYS

A world's record has recently been made by the Grays Harbor Motorship Corporation, Aberdeen, Wash., who has built a 4000 ton d.w.c. wooden ship from laying the keel to the launching in 17½ working days.

VICKERS DIESEL ENGINES

Apropos our recent article on the large Vickers built and engined motor tanker "Santa Margharita," this well-known British concern has had previous experience with merchant-ship type Diesel engines, apart from extensive construction of submarine engines, having built the motors of the Admiralty tanker "Olympia," which was fitted with two of their eight cylinder 17 in. bore by 27 in. stroke four-cycle type Diesel engines, each developing 750 b.h.p. at 150 r.p.m. As each cylinder was rated at only 93½ h.p., it will seem that their first attempt was both moderate and judicious. They also built another motor tanker for the Admiralty.

LARGE FRENCH MOTOR WARSHIPS

In our September and October issues we published official photographs of two large French motor warships of a special type used for convoy duties and submarine patrolling, one being a two-funnelled vessel and the other a single stack ship. We omitted to mention that these remarkable warcraft are propelled by Schneider-Diesel oil-engines of high power. Recently we had the pleasure of meeting an American naval officer who had been aboard these motorships. They are distinct from the twin-screw 840 b.h.p. Sulzer-Diesel engined craft.

"TROLLTIND," A NEW AMERICAN-BUILT MOTORSHIP OF 3000 TONS D.W.C.

There was recently launched at the Elliott-Bay Shipbuilding Company's yard, at Seattle, the wooden motorship "Trolltind," a 3000-ton Diesel-driven vessel built to the order of the Anglo-Norwegian Shipping Agency, 17 Battery Place, New York City. Her dimensions are as follows:

Length	260′
Breadth	46′
Depth of Hold	26′
Power	1000 b.h.p.
Speed	10 Knots

She is a twin-screw full-powered ship and will be fitted with two six-cylinder 500 b.h.p. Winton reversing Diesel engines of the four-cycle, trunk-piston, single-acting type, which at the time of writing are en route from Cleveland for Seattle. Her designer was L. H. Coolidge, of Seattle, and her chief engineer will be C. W. Newton.

AUSTRALIA'S 27 LARGE MOTORSHIPS

Shipbuilders in Australia have received orders from the Government for six wooden auxiliary motor-vessels of 2600 tons each and six of 2300 tons each, and it is possible that six will be built in Western Australia. These are in addition to the wooden motorships "Cethana," "Culvuna," "Chelamba," and "Coolcha"—the four 3200 ton Diesel vessels built on the Pacific Coast, and the five Diesel-driven vessels of larger size building at the Patterson MacDonald Shipyard, Seattle, Wash., and the 8000 ton steel motorship "Kangaroo," which vessel has been in the service of the Western Australia Commonwealth for several years. These make 27 motorships of over 2,000 tons d.w.c. that the Australian Government soon will possess, so that this Dominion soon will be quite an important motorship owner.

JAPANESE MOTORSHIP SOLD TO FRANCE

The Japanese-built motor-driven cargo vessel "Misago Maru," built in 1915 by the Osaka Iron Works, and fitted by them with a heavy-oil engine, has been sold to French owners in Paris.

GERMAN CONCRETE MOTORSHIP FOR BALTIC TRADE

For trading between Hamburg and Sweden a Ferro-concrete motorship of 800 tons d.w.c. has been ordered by the Baltic Shipping Company of Hamburg.

NEW BRITISH LINER FOR NORWAY

The SS. "Stavenger," steam-driven, a liner of 12,762 gross tons and 530 ft. length, has just been completed for the Norwegian-American Line of Christiania for service between New York and Norway. She has a speed of 17 knots and was built by Cammell, Laird & Company, of Birkenhead, England.

GERMAN SHIPBUILDING

Apropos the announcement in the October issue of "Motorship" that powerful German interests were laying down a big Diesel motorship yard, we note that merchant-ship construction has not entirely been abandoned in Germany since the war, and all together 213 power-driven vessels aggregating 445,000 tons gross and six (6) sailing vessels of about 14,000 tons have been built in Germany during the four years of war. This represents approximately three-quarters of one million dead-weight capacity. These figures are given by Lloyds Register of Shipping, but are not verified.

MOTORSHIPS IN HOLLAND

In the article on motorship-building in the Netherlands, in the September issue of "Motorship," no mention was made of the new vessel "Adriana," a 248-ton (gross) three-masted schooner built this year by J. J. Bodewes, at Pannerden, to the order of the N. V. Vrachtraart Maats Neerlandia, of Rotterdam. This vessel is fitted with a heavy-oil engine, built by J. Boot, Alphen a/a, Ryn, Holland. Also in their communication on page 28 of our October issue, Werkspoor, of Amsterdam, stated that the largest motorship being built by them is of 7000 tons. This should have read 9700 tons.

NOTEWORTHY NEW REVERSING SYSTEM

Particular attention is drawn to the new system of reversing mechanism for Diesel engines illustrated and described in the Patent section of this issue which will be of considerable interest because its low cost of construction also renders possible and practical the manufacture of small reversing marine Diesel oil-engines, as it allows of safe starting with three-cylinder, four-cycle type motors. Another reason for its interest is that it will be adopted for the 20 Werkspoor-Diesel 1100 i.h.p. engines now being built in the U. S. A. for the Emergency Fleet Corporation by the Skandia Pacific Oil Engine Co. of San Francisco, Cal. Its designer, Mr. Gerard Lugt, now is the Chief-Engineer of the Diesel Engine Department of the Werkspoor Works, Amsterdam, Holland, he previously having been the designer for Weyher & Richemond, of Paris, one of the three French constructional licensees of the Werkspoor-Diesel engine. It seems to be the most simple system of reversing ever fitted to any four-cycle Diesel engine, and Werkspoor have adopted it as standard practice.

GERMAN MOTOR MINE-SWEEPERS

A considerable number of German motor-driven mine-sweepers are employed in the Dardanelles. These vessels are about 65 ft. in length.

MOTORSHIP BUILDING AT BUENOS AIRES

A 500-ton d.w.c. motorship has been launched at the yard of Manuel Mendez and Company on the river Tigre at Buenos Aires. She will be fitted with American-built Diesel crude-oil engines and will run between the Argentine and the United States. Very shortly vessels of 2000 tons will be laid down at this yard.

WHAT AN OIL-ENGINE CAN DO

A U. S. naval officer recently told us about the operation of a little oil-engine driving an electric generator on a merchant ship with which he recently was serving. On one voyage the engine ran for 57 days and nights on Mexican fuel-oil without a single stop. On the next voyage this motor ran for 69 days and nights on gas-tar oil-fuel, also without a single stop. The engine subsequently opened up and no traces of carbon were found on the piston. In fairness to the makers, we will mention that it was a Fairbanks-Morse surface-ignition type engine.

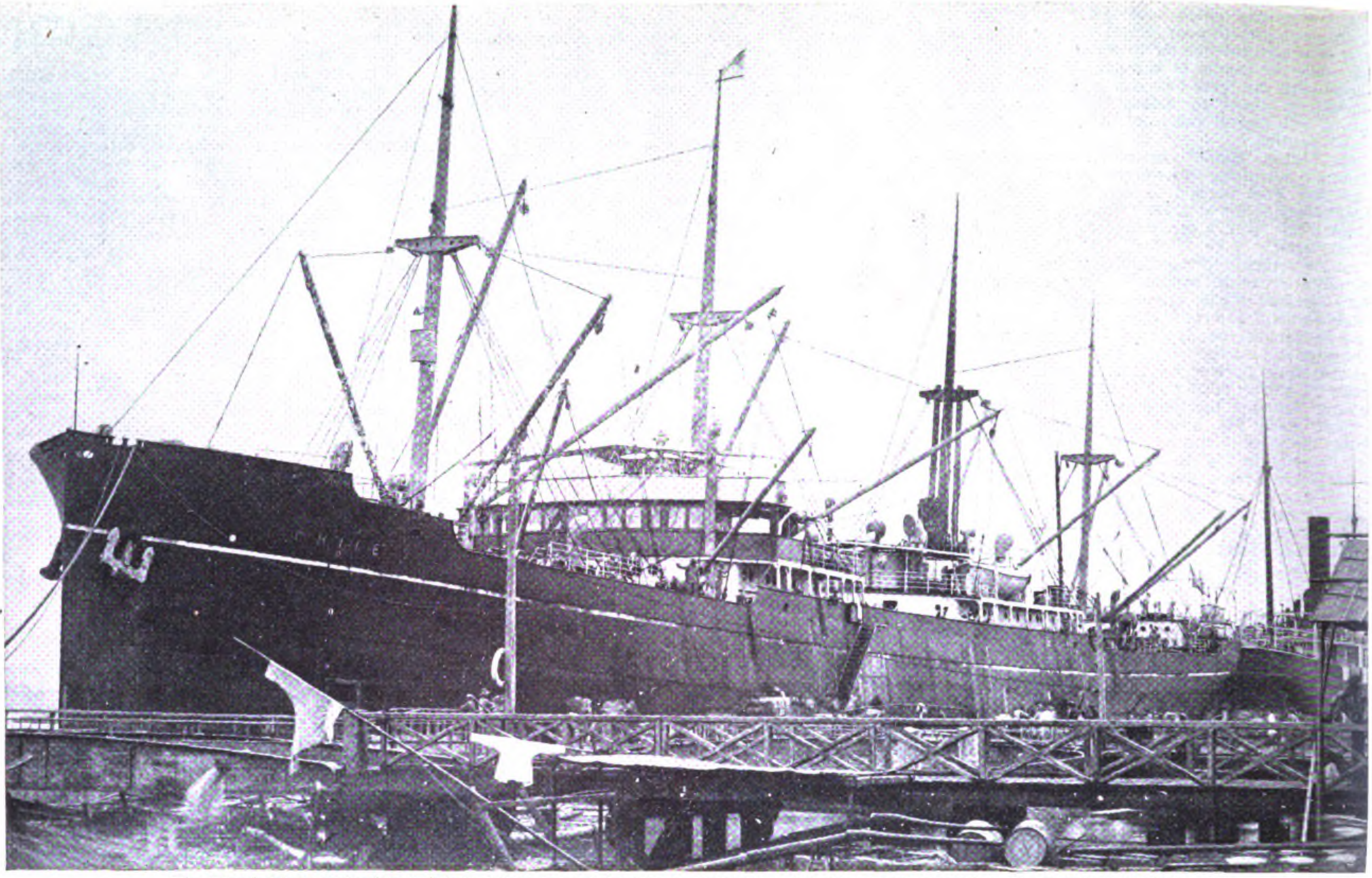
THE MOTORSHIP "GEORGE WASHINGTON"

This well-known Danish motorship, of which we publish plans on another page, recently made a passage from the Sandwich Islands to San Francisco in eight days on a consumption of but five hundred and eighty-four barrels (84 tons) of oil-fuel, with nearly 10,000 tons of sugar aboard. It would be impossible for an oil-fired, or coal-burning steamship of her dimensions to make such a record, which is quite an ordinary performance for modern Diesel-driven motorships. That is why America must have hundreds of steel motorships! In view of the remarkable record of performances of this ship that have been secured first-hand by the U. S. Shipping Board, is it not difficult to understand why the Emergency Fleet Corporation continue to order further geared-turbine and reciprocating steam-driven cargo-vessels?

The dimensions of the "George Washington" are:

Length	425′ 5″
Breadth	55′ 3″
Depth	27′ 7″
Gross Tonnage	5633 tons

She is equipped with two six-cylinder 24 13/16 in. bore by 37 13/16 in. stroke B. & W. reversible Diesel-type marine engines of the crosshead, single-acting, four-cycle class. Her owners are the Aktieselskabet Borga (P. Olsen, manager), of Christiania, Norway.



The Diesel-driven motorship "Chile." When in port, loading or unloading, she only uses three (3) barrels of oil-fuel for 24 hr. day

Visit to a Large Danish Motorship

Vessel of 13,400 Tons Displacement Brings 11,400 Tons of Sugar From 'Frisco to an Atlantic Port on 240 Tons of Fuel

FRANKLY we do not know of an instance where a shipowner has been aboard a large modern steel motorship and has come away unconvinced that the coal-burning steamship has seen its day as an ocean-carrier of freight. Also, the full import of the value and practicability of the internal-combustion oil-driven motorship only can be gained by a visit to such a vessel; so, surely it is in the nation's interest that every responsible official of the U. S. Shipping Board and Emergency Fleet Corporation should inspect at least one of these large foreign motorships regularly calling at American ports.

Such a ship recently visited an Atlantic Coast harbor, and as she has been given safe passage conduct both by Germany and the Allies, there is no reason why her name cannot be mentioned. We refer to the motorship "Chile" of the East Asiatic Company's Line—a steel motorship placed in service 2½ years ago.

Although of but 13,400 tons loaded displacement, she brought no less than 11,400 tons (2000 lbs. to the ton) of sugar in bags, yet only consumed 240 tons of oil-fuel out of the 400 tons bunkered at 'Frisco. Owing to having been laying in port for several months awating sailing permits, her bottom was very dirty, so she took 27 days for the trip instead of the 22½ she usually requires. Despite this, where could a steamer of the same dimensions be found that could equal the feat? Such a steamer is non-existent, because the latter could not carry more than about 10,000 tons without going below her Plimsol mark.

The maximum draught of the "Chile" on this voyage was 28 ft. 4 in. She has the folowing dimensions and is a twin-screw vessel:

Loaded Displacement	13,400 tons
Maximum Cargo Capacity	10,000 long tons
Dead-weight Capacity (26′ 3″ draught)	9,400 long tons
Gross Tonnage	5,570 tons
Net Tonnage	3,490 tons
Bunker Capacity	1,200 long tons
Cruising Radius	120 days
Length Over All	425′ 5½″
Breadth	55′ 0″
Max. Depth of Hold	38′ 6″
Normal Draught	26′ 6″
Max. Draught	28′ 6″
Light Draught (Average)	9′ 0″
Total Propelling Power	3,150 I.H.P.
Propeller Speed	125 R.P.M.
Average Sea-Speed Maintained	10½-11½ Knots
Propeller Pitch	10 feet
Daily Fuel Consumption	9½ to 10 tons (701 lbs.)
Engine-Room Crew	4 engineers 5 assistants, 4 oilers

She was built and engined at Copenhagen, her B. & W. motors being of the reversib.e, four-cycle crosshead type, each having six cylinders 633 mm. (24.95″) bore by 960 mm. (37.79″) stroke and turns at 124 to 128 r.r.m., but can run steadily under load at 42 r.p.m. when desired for a considerable period. This sea-speed is a little higher than some Diesel engines of this power. Cylinder compression is about 470 lbs. per sq. inch, or about 60 lbs. higher than will be the compression of some of the new Diesel engines of another type building for the U. S. Emergency Fleet Corporation. An interesting point for ships' engineers to bear in mind is that the highest temperature recorded in the machinery-room was 40 degrees centigrade between Panama and Colon, and the lowest, 26 centigrade.

Her bottom is equipped with the usual ballast-tank between frames, and these are used for the bunker-oil; but on the trip from 'Frisco only 400 tons were carried, although 1200 tons can be shipped without interfering with her great cargo capacity. All the deck-winches are of the electric type, and she can load and unload considerably quicker than a steamer of her size. Her steering-gear is Hele-Shaw electro-hydraulic, built by Hasties, of Great Britain. It only uses a current of 8 amperes, so is most economical in operation.

Most of the B. & W. engines use oil-cooling for the piston, but these motors use salt water for this purpose, and Chief Engineer F. W. Moller considers it much better than oil for the purpose. This is quite interesting, as there is still quite a difference in technical opinion existing regarding the merits of oil and salt water, respectively. About 30 tons of sea water is used per hour for the entire engines, and the water is discharged at about 45 degrees centigrade.

The main air-compressors are driven directly off the forward end of each engine, and are of the three-stage type, delivering air at 60 to 65 atmospheres for fuel-ignition. Even at 40 r.p.m. they compress sufficient air. These compressors pump into two heavy bottles arranged between the two engines, and they can stand a pressure of over 1000 lbs. per sq. in.

Compressed air is also required for starting, at lower pressure (about 25 atmospheres) but in much greater volume. This comparatively low-pressure air is contained in two tanks of some 500 cu. ft. each, suspended from the deck above on the starboard side of the engine room. Air for these tanks is furnished by an auxiliary air compressor, operated by an electric motor of about 90 h.p., using current at 340 amp. This compressor, running at 250 r.p.m., handles about 7 cu. metres of air per minute. Besides pumping up the starting-tanks, this compressor is able, with one of the main compressors, to keep up the necessary injection pressure for full-load operation of both main engines.

Further provision, also, is made against the possibility of running out of compressed air for starting and injection. At the after end of the engine room is a small oil-fired boiler with a working pressure of 80 lbs., intended to furnish steam for heating, baths, etc., for fire extinguishing, and to operate a small 2 h.p. emergency compressor. This compressor can in one hour fill one of the 150-litre air flasks from empty to a pressure of 60 kg. per sq. cm. It never has had to be used.

All auxiliary machinery on the "Chile" is operated by electricity, the current being furnished by three generating sets, located on the port side of the engines. The dynamos are of 60 kw. capacity each, and are direct connected to 4-stroke, 2-cylinder Diesel engines, of 120 i.h.p. each at 300 r.p.m. The dynamos supply current at 220 volts. One of these generator sets is in constant use while at sea, supplying 110 amperes, which is ample for all auxiliary equipment; thus always leaving two generator sets to fall back on in case of accident. Two of the engines are operated in port, the extra current being needed for handling cargo; but there is always one generator set in reserve.

The crank, crosshead-guide, main thrust bearings, etc., are of types familiar in steam engines;

the crankshaft being built up. The bearing parts of the crankshaft are 15 in. dia., and the crankshaft weighs 25½ tons, with a 7-ton flywheel for each engine.

There are two sets of motor-driven centrifugal circulating pumps for water-cooling the engines. These have a capacity of 75 tons per hour, against

Chief Engineer F. M. Moller, of the M.S. "Chile"

a head of 25 metres, operating at 1000 r.p.m., using current at 220 volts, 32 amp. Each pump has a suction from the engine room bilge, and from the sea on both sides of the engine room; an improvement being the placing of the starboard inlet 6 ft. higher than the other, for use in shallow water.

There is a large settling tank to which the oil is pumped from the bunkers, to permit the segregation of any water or dirt that may have gotten into the oil. This is a matter of considerable importance, as the introduction of any water into the cylinders with the oil is undesirable, and even at best causes a tendency to fouling. There are also two 6-ton daily run fuel tanks in the engine room, which are drawn upon alternately. A special pump of 50 tons per hour capacity is used to pump the oil into the settling tank, or from one tank to another.

Two sets of pumps are used for forced lubrication, operating at 300 to 400 r.p.m., according to oil pressure. At sea, with a pressure of about 1 kg. per sq. cm., the pumps handle about 12 to 18 tons of oil per hour, running on 15 to 20 amp. current. There is a lubricating oil tank for each main engine, carrying 6½ tons of oil.

Other auxiliary engine room equipment includes: two sets of bilge and sanitary pumps; on each set are two pumps for the bilge, of 20 tons per hour capacity, and one pump for the sanitary tank, of 15 tons per hour capacity, each set being operated by a motor at 20 amp.; one ballast pump of 150 tons per hour capacity; one motor-generator set furnishing 110-volt current for lighting, with a capacity of 16.5 kw. at 1000 r.p.m.; and one motor for operating the lathe, drill-press and other tools in the repair shop.

With engines at about 125 r.p.m., the "Chile's" average sea speed has been about 11.1 knots. At this speed the fuel consumption of the main engines at sea is about 10 tons per day, or 135 grammes per indicated h.p. The auxiliary engines, with one running at sea, use 0.170 tons fuel oil per day, or 145 grammes per indicated h.p. in port, with two engines running, the auxiliaries use 0.4 to 0.5 tons per 24 hours (about 3 bbls.). The consumption per day at sea of cylinder oil is about 15 kg.; of compressor oil, about 4 kg., besides about 3 kg. in hand lubrication for both main and auxiliary machinery. With more or less leakage, the loss of oil forced lubrication varies considerably.

Careful attention and close adjustment are of course essential to the successful operation of this type of engine, mechanical precision in handling as well as in construction being of more importance than with the steam engine. The "Chile's" engines have been handled in a competent manner, and have given no trouble of any consequence whatever since their installation. Only two cylinder-heads have cracked, and these were successfully welded, and are carried as spares.

As a typical example of what a well-designed motorship can do in ordinary operation, let us mention that the motorship "Chile" on one earlier voyage out of Copenhagen to San Francisco, to the Orient, and back to San Francisco, the port engine ran 1862.24 hours full speed and 42.14 hours slow when going into port, and through the Panama Canal; making 1905.38 hours of actual operation, with two stops at sea totaling 6.25 hours. The total revolutions made by this engine on this voyage were 14,036,870. The starboard engine ran 1866.49 hours full speed, 42.14 hours slow, or 1910.03 hours altogether, with a total of 14,083,170 revolutions. It was stopped three times at sea, with a total of only 2 hours stop.

The distance traveled on the entire voyage—from Copenhagen to Christiania, Stornoway, St. Thomas, Colon, San Francisco, Yokohama, Kobe, Shanghai, Kobe, Yokohama, San Francisco—was 20,450 miles; and for the whole distance traveled at sea the speed was 10.94 knots. From Yokohama to San Francisco, with little cargo, the speed was 11.44 knots at 128 r.p.m. The fuel consumption of the main engines, using Union oil, from California, for the entire voyage, was 796.35 tons. The electric lighting engines during the same time used 7.4 tons, and engines furnishing current for the winches, 16.9 tons, making a total of 828.9 tons for the entire voyage.

During the same time the amount of lubricating oil used was 1845 kg., including cylinder, compressor and small bearing lubrication of both main and auxiliary machinery. Of the pressure-lubricating oil there was a loss of about 2.5 kg., largely due to cleaning out of lubricating oil tank during the stop at Shanghai. The running time of the auxiliary engines during this voyage was as follows: No. 1, 1088.45 hours; No. 2, 1240.20 hours; No. 3, 1312.15 hours.

Will it not be well for all steamship owners to ask themselves where there exists a steamship that could operate in competition with this vessel, especially in a few years to come, when more normal conditions are resumed and when Oriental and European shipowners are striving to carry the maximum part of the world's product? While at war, prepare for peace! Building motorships will accomplish this post-war preparation, and at the same time will assist to bring victory nearer to us.

MOTORSHIPS FOR PRIVATE ACCOUNT

The U. S. Shipping Board under its present policy will receive and consider applications for construction for foreign account of wooden sailing vessels, including auxiliaries, up to 1000 tons deadweight capacity. Each application, however, is considered on its own merits. The Shipping Board contemplates in the near future a general statement of its policy as to construction for private account.

GERMANY'S INVASION MOTORSHIPS

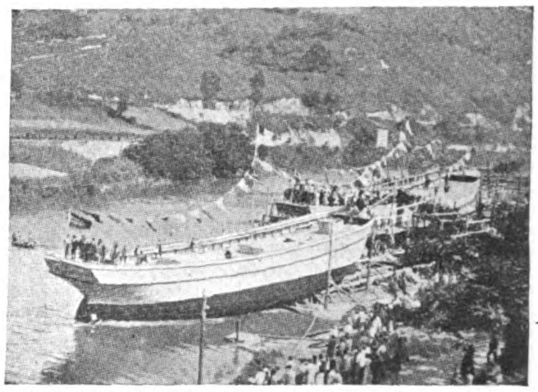
Shortly after the outbreak of war the German Admiralty built 30 Diesel-engined motor transports at the Howaldt's works and at Krupp's, each capable of carrying 500 soldiers, and were of shallow draught. They were intended to be used in conjunction with other ships, for the invasion of England. Doubtless they now are useful for supplying the German Fleet in the Kiel Canal.

OUR WOODEN STEAMSHIPS

Writing to the "Nautical Gazette" in reference to the new wooden steam-driven merchant ships, Mr. Robert Dollar, one of America's best known steamship owners, says:

> "The cost of operating one of these vessels after the war will be more than the cost of operating an up-to-date modern steel 10,000-ton foreign steamer. In some instances they are burning more coal than the 10,000-tonners, and the number of the crew will be about the same, but with a much higher pay-roll, so they are utterly unable to meet the competition of the large modern steamer.
>
> "Shipping men of experience have given this matter much thought, and I have not found one that could give a reasonable and correct solution of what will be done to save these ships from the scrap heap. So far many have had engine troubles."

Mr. Dollar echoes the remarks made many times by "Motorship." The only way in which it will be possible to operate these vessels after the war will be to scrap the steam-machinery and install oil-engines—provided the hulls are staunch and sound.



Launch of the 100 b.h.p. motor-auxiliary schooner "Julita Cadagua," at the Astillero del Cadgua, Bilbao, Spain. A sister motorship can be seen on the slipway

Photo.—Courtesy of Shipbuilding & Shipping Record (England)

An experimental reinforced-concrete motorship taking the water at Barcelona, Spain. She is being fitted with a Bolinder heavy oil-engine and was built on the beach without proper launch-ways by the Construcciones y Pavimentos Co., Ltd., so she was subject at the moment of launching to stresses and strains which no steel or wooden ship would have withstood without some damage. Note the crude planking used as slipways. The same company are building concrete motorships of 1200 tons d.w.c. at their Malgrat shipyard.

MORE SPANISH WOODEN AUXILIARIES

Three slipways with room for five 350-ton motor-auxiliary wooden sailing-ships have been erected on the Cadagua river, Bilbao, Spain, and the shipyard is known as the Astilleros Caduga. We give an illustration showing the launch of the "Julita-Cadagua," the first of these motor-vessels. The oil engines are of 100 b.h.p. each and are constructed by the Calva et Cia of Bilbao. Two motor-launches and two motor fishing vessels also are building at the above shipyard.

MORE "BOILERLESS" DIESEL ENGINES NEEDED

"The boiler position on the Tees at present is unsatisfactory, as requirements cannot be met without assistance from inland manufacturing centres. Those requirements should be greatly increased in the near future, not only for boilers, but for engines, and if not adequately met, the production of ships will be handicapped. Fortunately this company was in a position to meet the demand for engines. They had, however, no corresponding capacity for boilers, consequently their departments were badly out of balance, a condition which certainly did not promote either maximum or economical production."—*The Chairman (Mr. D. B. Morrison) at the annual meeting of Richardsons, Westgarth & Co., Ltd., Hartlepool, England.*

PORTUGESE MOTOR GUNBOAT

Even Portugal has a motor gunboat in service—this is a small vessel fitted with two M. A. N. Diesel oil-engines of 300 b.h.p., each at 500 r.p.m.

The British Welded-Steel Motorship

Details of the Method of Operation of the Novel Type of Oil Engine Installed in this Noteworthy Merchant Vessel

CONSIDERABLE interest was aroused by the announcement in our September issue that Cammell, Laird & Company, of Birkenhead, England, are building an entirely novel class of oil-engined motorship which is to be propelled by a new type of marine heavy-oil engine from which great things are expected. This motor is a development by Cammell-Laird from the Fullegar opposed-piston, two-cycle oil-engine, which in one sense closely resembles the well-known Junkers principle, yet is quite different. When this British shipbuilding concern constructed the old gunboat "Constitution" in 1875—which, by the way, was converted to oil-engine power several years ago—little did they think that today they would be engaged in completing what may eventually prove to be the commencement of a new era in merchant-ship construction, both the hull and machinery being radical departures from conventional shipbuilding and marine engineering practice.

Of course, there is no need for a wild rush to construct similar craft in large numbers, as both the hull and engines may not prove as nearly as efficient as expected. But it shows two things. One being that the builders have plenty of confidence in the designs or they would not have undertaken the risk in these war times. Secondly, it reveals that no matter how hard-pressed Great Britain becomes during the war, she is not going to ignore reasonable developments, and preparation for after-war business, as instance this case, also the successful completion of the world's highest-powered four-cycle Diesel motorship related on another page in this issue. We in America have gone into this great war so heartily and with such a strong intention to win it regardless of everything else, that some Government officials and many large private companies are entirely forgetting the absolute necessity of continued engineering development. If we are not careful we may find an impassable barrage ahead and tear-gas behind.

During the war a great many engineering devices, engines and machines have been developed abroad, some of them under sheer war pressure, others by the natural course of progress that even war could not hamper. Instead of our manufacturers seeking out most of these valuable inventions and adopting them, or improving them in the usual American fashion, they merely decide that they are far too busy with the work in hand, and that they can only attend to manufacturing products for winning the war which now fill their factories and shipyards. Too rigid an adherence to such a policy is a mistake—both for the nation's present and future benefits, and many foreign developments even could assist this country to win the war.

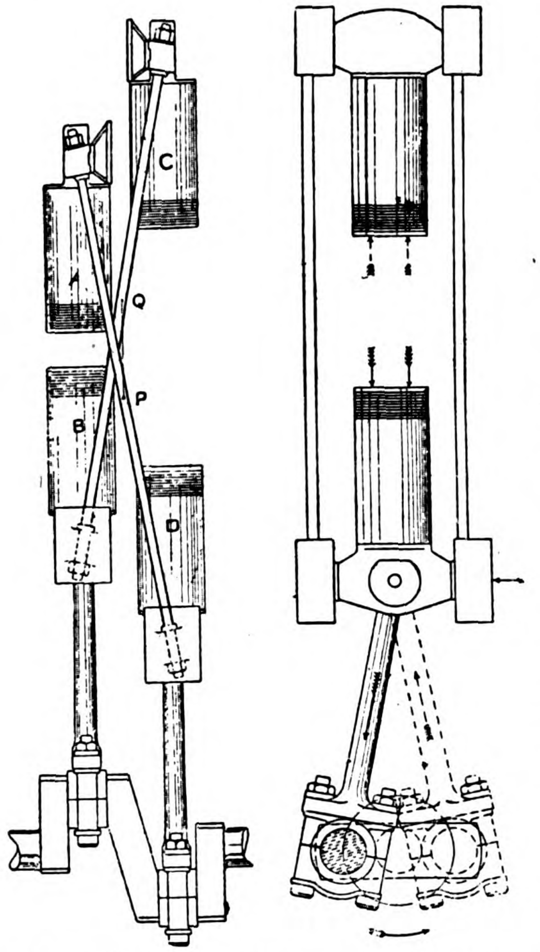
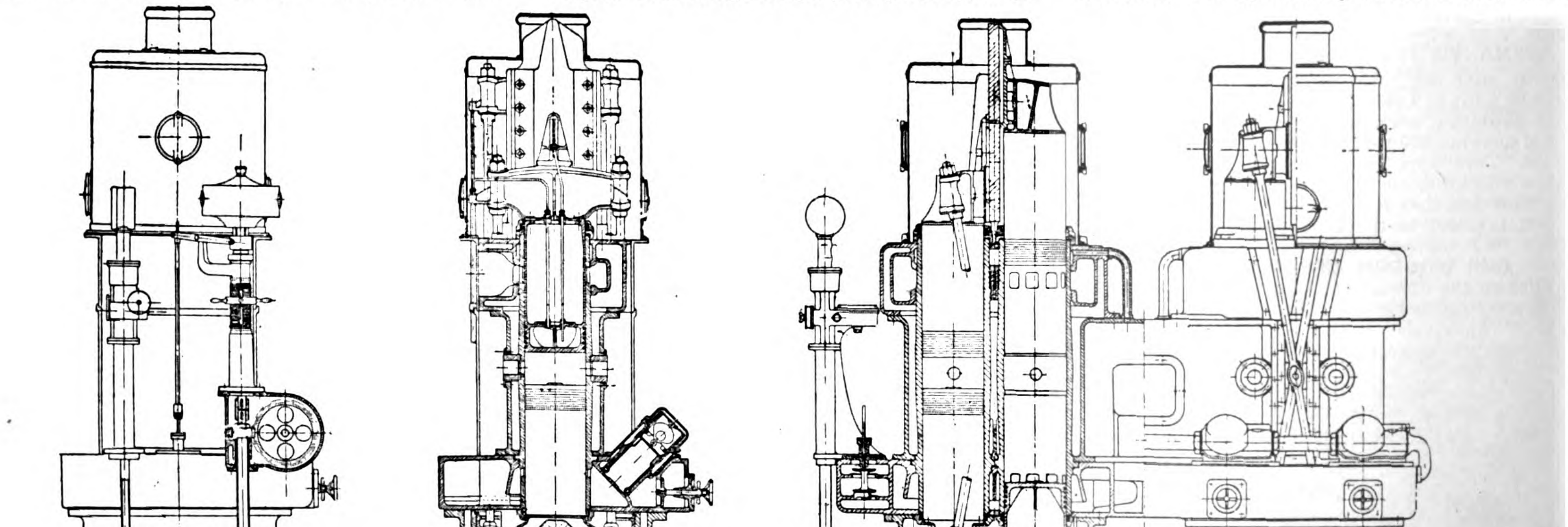


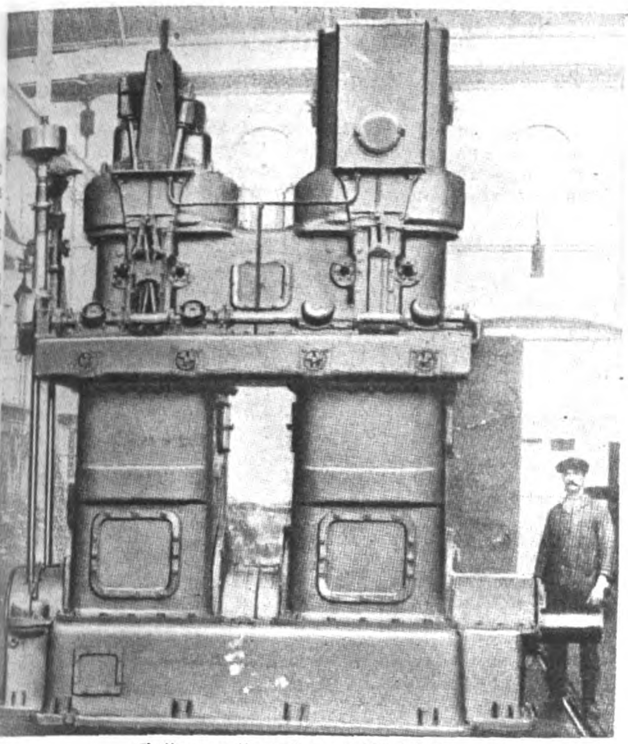
Diagram illustrating Fullegar principle of operation

Unfortunately, the British authorities still are maintaining their stringent censorship with all things pertaining to merchant Diesel motorship construction, although they freely have permitted publication of complete details and illustrations of their new standardized steamships. Obviously they must realize that the motorship is the only post-war type of merchant ship, and naturally may be somewhat reluctant to freely distribute such data, particularly with an entirely new class of ship, such as the welded steel vessel for which success is not yet assured.

However, "Motorship" is enabled to place before its readers considerable information concerning a 500-b.h.p. Fullegar heavy-oil engine, which really is the pioneer of the Cammell-Laird-Fullegar engines of the new electrically-welded steel motorship. This engine was designed by Mr. H. W. Fullegar, of Newcastle-on-Tyne, and was constructed by W. H. Allen Son & Company, of Bedford, England. It will serve the purpose of explaining the principle of operation and design to our readers, and later on we hope to give details of the engines actually installed in the ship. This engine is a vertical model, with four double-cylinders, 12 in. bore by 18 in. stroke, and was designed to develop its rated power at 250 r.p.m., but has developed 550 b.h.p. continuously. Of course, it is smaller and of faster speed than the two heavier-duty units in the Cammell-Laird ship; but its piston speed is 750 ft. per minute, which is not at all unreasonable, so probably the big marine engines even have a lower piston speed. It is claimed by the designer that eight pistons with four cranks produce a given power of one-half to one-third the weight required by other designs, so are equivalent to twelve cylinders of a four-cycle engine. This 550 b.h.p. motor weighs 20 tons and the mean effective pressure is under 70 lbs. per square inch. The mechanical efficiency is about 90%.

Regarding the principle of operation, as with the Junkers engine it operates on a two-stroke cycle, and each cylinder has two pistons—one above the other—moving away and towards each other every alternate stroke, forming between them, at their


General arrangement and sections of a 550 b.h.p. Fullegar oil-engine



Fullegar oil-engine of 550 b.h.p.

nearest points of almost contact, the combustion space, so that the fuel is injected into the compressed air in the space formed by the two nearly meeting pistons, as in the Junkers motor. However, the similarity between the two types ends at this point, and this shall be borne in mind.

It will be noticed from an examination of the sectional drawing that the cylinders are arranged in two pairs, and that two adjacent cylinders are very close to each other—in fact, are only separated by the water-jacketed space between the two cylinder walls. This design is essential with the arrangement of drive to the crankshaft which is employed. Taking one pair of cylinders, it will be seen that the top piston of the left-hand cylinder is connected by means of an oblique rod to the crosshead of the bottom piston of the right-hand cylinder, and similarly the bottom crosshead of the left-hand cylinder is connected to the top piston of the right-hand cylinder. By this means a cushioning effect is obtained, so that the stresses are largely counterbalanced and bearing troubles are therefore said to be entirely avoided. When it is remembered that one of the difficulties of the opposed-piston engines of the heavy-oil type for marine work is the fact that the bearing stresses are so excessive, it will be seen that this is an important point. The arrangement of the crankshaft is an obvious confirmation of the satisfactory nature of this design, and there is no main bearing between the two adjacent cylinders. In fact, if the bearing were necessary, the design itself would be almost unworkable.

The good scavenging effect common to motors of this type is obtained, the scavenging-air entering through ports round the whole of the periphery of the cylinder at the bottom, and the exhaust gases escaping through similar ports right at the top of the cylinder. The scavenging effect is therefore one of sweeping out the whole of the exhaust-gases by a cylinder of air rising from the bottom.

The method of joining the pistons of adjacent cylinders by oblique rods which at first sight seems somewhat unmechanical, can be seen from the illustration to be a simple and sound method of carrying out the idea. The rods are comparatively light, their obliquity is small, and they do not interfere in their action with any other part of the engine, being in the ordinary way totally enclosed by plates, as seen on the right in the photographic illustration. It is too early to offer a definite opinion on the capabilities and possibilities of this motor for marine purposes, and particularly in large powers, so this new ship will be awaited with interest.

There is still the possibility of cracked cylinder liners, especially in the neighborhood of the points where holes are drilled for the insertion of the fuel-valves, of which presumably there would be two for each cylinder. This is, however, a difficulty in design which, in the normal course of events would be overcome. The cylinders themselves are simply cast-iron barrels, slightly thickened in the center, and the water-jacket is arranged to go right around the whole of the four cylinders, being supported on the trunk, which supplies the scavenging air, and itself supports the exhaust chamber into which the exhaust gases are discharged. The motor is of the enclosed type, in that each pair of cylinders is totally enclosed with a space between the two pairs, and forced lubrication is therefore adopted throughout, a small eccentrically-driven oil-pump being fitted on the crankshaft.

The motor certainly appears overcome of the main difficulties met with in the design of this type of engine, and, provided no new and unexpected troubles accrue, particularly in connection with the big end bearings, the prospect of its adoption for marine work appears to be satisfactory. This difficulty is, of course, the question of bearing pressures; but, as the pressure of the explosion in the cylinders acts upward on the upper piston and downward on the lower piston of one cylinder, it therefore neutralizes the bearing pressure, since the forces upon each pair of cranks are equal and opposite. To remove one of the top pistons the cover can be taken off and the two nuts fixing the oblique rod removed, after which the piston can be taken out. The lower piston can then also be drawn up through the cylinder and out at the top.

Doubtless the inventor, and Cammell-Laird, have been able to considerably improve upon this engine from experiences that naturally must have accrued. As another instance of their confidence, they even are ready to dispose of constructional licenses for their latest marine engine, so it behooves American engineering companies to immediately make a close investigation so as to ascertain if it warrants adoption and construction in the U. S. A. for some of the ships of our future merchant marine. Possibly the U. S. Shipping Board will think it fit to send an engineer to investigate.

The Coming of the Rivetless Steel Ship

By THE U. S. SHIPPING BOARD

[*Editorial Foreword.*—Facing this page are given details of the design of the special type of Diesel oil-engines being installed in the electrically-welded rivetless steel motorship now under construction in an English shipyard of repute. From the following official statement it looks as if the construction of a welded-steel vessel soon will be started by the U. S. Emergency Fleet Corporation, and it is to be hoped that the officials responsible will avoid the error of installing steam propelling machinery, but will follow the excellent example of our British friends. Let us remember that while America is accomplishing remarkable work in shipbuilding, her shipbuilders, with a few exceptions, are comparatively novices at the game, so it will be no disgrace to learn a lesson from veteran British shipbuilders.—*Editor.*]

THE building of a steel ship in three-quarters of the time and at three-fourths the cost heretofore necessary—this is the latest revolution promised in the sphere of shipbuilding. Instead of the long-prevailing, laborious and expensive method of riveting, successful experiments indicate that steel ships can be put together by the simple process of electric welding.

After exhaustively investigating electrical welding, the Electrical Welding Committee of the United States Shipping Board Emergency Fleet Corporation is so well satisfied as to the practicability of this process that it has formally urged that a 9300 dead-weight ton ship be built by electrical welding. This recommendation has not as yet been approved because of the general sentiment among the body of experts that a smaller ship should be first constructed. Meanwhile, there is about to be built for demonstration purposes at the yard of the Federal Shipbuilding Corporation, at Kearney, N. J., a 42-foot electrically-welded mid-ship-section of a 9600-ton ship. The methods of assembling and welding to be used on this section are due to A. J. Mason, Consulting-Engineer for the United States Shipping Board and member of the Electric Welding Committee.

There are electrically-welded vessels already in operation and giving good service. They are small, it is true, but they definitely establish the principle. When in June, 1918, there was launched in England a 275-ton barge built as a demonstration of what could be done by constructing wholly of electrical welding, the claim was made that this was the first electrically-welded boat ever built. But to America belongs the credit of the first vessel put together by electrical welding. Several years ago Mr. Geary, of the Geary Boiler Works at Ashtabula, Ohio, built a 60-foot tug by the welding process. It has been in service on the Great Lakes, and has given great satisfaction.

Many are the advantages that an electrically-welded ship is regarded as having over the riveted ship. In a 5000 ton ship about 450,000 rivets are used. A 9500 dead-weight ton ship requires 600,000 or 700,000 rivets. By the welding process the saving in labor on the minor parts of a ship is reckoned at from 60 to 70 per cent. On the hull plating and other vital parts, the saving in labor, cost and time of construction by welding is conservatively placed at 25 per cent. Moreover, welding means a considerable saving in weight. By not having to use rivets, the saving in weight on the hull of a 9500-ton ship would be 500 tons, and the ship could thus carry 500 tons more cargo.

For doing the work of riveting great physical strength is needed. But welding can be done by women as well as men. Even one-armed men can do welding. With the new draft calling out a still greater proportion of America's man power, the adoption of the welding process would thus insure a much larger radius than now from which to draw the labor needed to build our ships. In fact the new big shipyards haven't nearly the quota of riveters they need. Under the welding process both men and women can be brought in. The men who are now riveting can easily be transformed to welders. To train a welder requires just about the same time as to train a riveter.

That electrical welding will some day largely replace riveting is the judgment of the Electrical Welding Committee, composed of 82 of the leading experts in both the electrical and metallurgical branches of the welding field. At the request of this committee, Captain James Caldwell, R.E., Deputy Assistant Director of Materials and Priority for the British Admiralty, was recently sent over to co-operate with the committee.

The coming in of the electrically-welded ship is shown by the significant action of Lloyd's Registrar of Shipping in England. It has taken a very active and progressive stand towards electric welding, and has spent large sums of money in experimental work. Recently Lloyd's issued provisional regulations under which they will separately classify ships built wholly by electrical welding. Of course, there will be no sudden transition on a large scale from riveting to electric welding. Existing shipyards are equipped with apparatus for riveting. They will need time to adjust themselves to new conditions. Time is also necessary to get the welding machinery and teach operatives.

It has been the great war that has brought the electric welding of ships to the forefront. The repairing of machinery of fifteen German and Austrian ships that were sabotaged in New York harbor in 1917 was done by electric welding, and done with great rapidity. [We believe that this was done by the Wilson system.—*Editor.*] It was the success of this operation that in part led to the appointment of the Committee on Electric Welding by the United States Shipping Board Emergency Fleet Corporation. In England not enough oxygen could be obtained to do the welding by the oxy-acetylene method. Electric welding was therefore resorted to, and it was found, on the whole, more satisfactory and cheaper for shipbuilding.

PROPOSED 36,000 H.P. BRITISH MOTOR LINER

It is not generally known that just before the war started, Barclay, Curle & Co., the Glasgow shipbuilders, in conjunction with the new North British Diesel Engine Works, were working on the designs of a Diesel motor-driven liner of 36,000 b.h.p. In fact, for these Diesel engine works the largest universal machine ever built was ordered, and this was capable for machinery parts of Diesel engines up to 12,000 h.p. Seeing that Barclay Curle's latest motorship, "Glenapp," is of 6400 b.h.p., the big triple screw motor liner is quite feasible today.

The Submarine Situation

Sir Eric Geddes Virtually Confirms Our Recent Review

In our review of the present submarine situation on page 24 of the October issue of "Motorship" and in previous issues we made the following statement:—

"The underseas warfare still is a serious factor to contend with, and that in consequence there must not be the slightest let-up in the rush of construction of merchant-vessels, destroyers, and large sea-going chasers. There is too much danger for us in over-confidence."

This was directly opposite suggestions that had been appearing in the "daily press," and such as recently had been made by several Allied Government officials; but we had confidence in our conclusion formed after a careful study of the situation.

In a speech at New York on Oct. 14th, Sir Eric Geddes, First Lord of the British Admiralty made clear the following points, all of which substantiate the remarks made in various issues.

(A) He is in complete concord with Secretary of the Navy Daniels as to the gravity of the outlook on the sea.

(B) The number of German submarines now is greater than ever before.

(C) A big German effort by underseas craft can be looked for.

(D) The U Boat is a menace that comes and goes.

(E) The German submarine can never win the war provided we take adequate measures against it.

(F) Submarines are being built faster by Germany than ever before.

(G) A great drive in the American shipyards for destroyers and other anti-submarine craft is very urgent and of paramount importance.

(H) There is no greater need today, than the need for the utmost naval effort against the great offensive of the submarine which is now materializing, and which the allied navies will defeat as they have defeated every other effort of the enemy. But that defeat can only be assured if this need is recognized and the wants of the two navies supplied.

(I) Great Britain has lost 2400 merchant ships aggregating 7,750,000 gross tons (11,580,000 tons d.w.c. approximately).

"Motorship" feels sure that America will beat all past efforts in the construction of anti-submarine vessels and thus bring victory nearer every day. For this purpose the marine Diesel-oil-engine should be utilized to the fullest possible extent.

New Norwegian Concrete Motorship

The new oil-engined freighter "Askelad" is the biggest concrete motorship in service in Europe at present, and has been very successful on her trials. She was planned for a dead-weight of 1000 tons and actually has a capacity of 1050 tons d.w. An illustration of her is given elsewhere in this issue. The speed also exceeded expectations inasmuch as the average speed of two trials was 8.8 knots. In one of her trials she made 9.2 knots.

When it is noted that the engines are two Bolinder motors of only 160 H.P. each, i. e. 320 H.P. for a ship of 1050 tons d.w., it is evident that the engine-power is far too small for the ship, no matter whether the hull is built of steel, wood or concrete, a fault also akin to nearly all recent American motorships. However, as in such cases, the owner of the "Askelad" decided on this size of engine, and the builders installed what was desired.

The concrete motorship "Stier" of 600 tons d.w., which we recently illustrated, had exactly the same horse-power, but only one engine, namely a Bolinder motor of 320 B.H.P. she being a single-screw ship. This boat made 8.6 miles and fully loaded with heavy cargo, approximately 8.1 miles. It is very interesting, and a great source of satisfaction to the builders, that the motorship "Askelad," being of 1050 tons d.w., is making better speed with the same engine-power than the motorship "Stier," 600 ton d.w. Both vessels have the same block co-efficient; 0.76; both vessels have the engines aft. This tends to assist the recent contention made in "Motorship" that under circumstances it is possible for a twin-screw ship to be more efficient than a single-screw vessel.

But, the explanation of the increased speed of the motorship "Askelad" probably lies principally in the greater length and the more perfect lines of the boat. It is doubtful if a steel or wooden ship with the same engine power and the same deadweight-capacity would beat this concrete ship in speed.

It is expected and hoped that the necessary permit required on both sides of the Atlantic will be granted for this vessel to cross the Atlantic as has been planned. Her owner is Oswald Rosenvold, Christiania, Norway, and she was built by the Fougner Steel-concrete Shipbuilding Company, Christiania, Norway. Length over all, 176' 0"; Length B.P. 170' 0"; Breadth over concrete 31' 0"; Depth molded 19' 0".

Photo.—Committee on Public Information. Copyright.

On the lookout for Hun U-boats

Photo passed for Publication

Launch of the Busch-Sulzer engined submarine R-24 at the yard of the Lake Torpedo Boat Co.

THE INTERNED SUBMARINE U-39

Now interned at Cartagena, Spain, is the German submarine U-39, of which we give an illustration, showing her guarded by the Spanish torpedo-boat No. 14 (the "Extremadura"). The U-39 has a submerged displacement, and was built between 1913 and 1915. Her length is about 210 ft. by 20 ft. beam, and is propelled by two 900 b.h.p. Diesel engines. She has a surface speed of about 16 knots. Her crew consists of 35 officers, engineers and men.

The Interned U-39

NO MORE STEAM AUXILIARY SHIPS

The Imperial Munitions Board of Canada has decided to place no further orders for wooden sailing vessels equipped with steam auxiliary propelling power.

CURIOUS FRENCH SUBMARINE

One of the most curiously looking submarines ever built was the "Mariette," a Radiguer designed craft 210 ft. long by 14 ft. beam, built at Cherbourg eleven years ago, and fitted with two Sautter-Harle 720 b.h.p. Diesel engines four years later. She could submerge in twenty-five seconds. Half her length forward was raised about ten feet above the stern half.

"Motorship" Illustrated Patent Record*

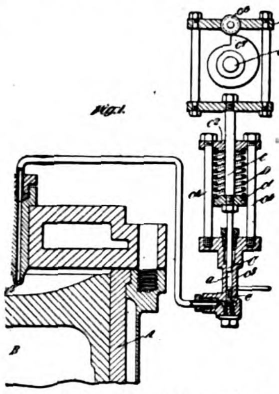
Selected Abstracts of Recent Published Patents of Internal Combustion Engines

Copies of original specifications may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

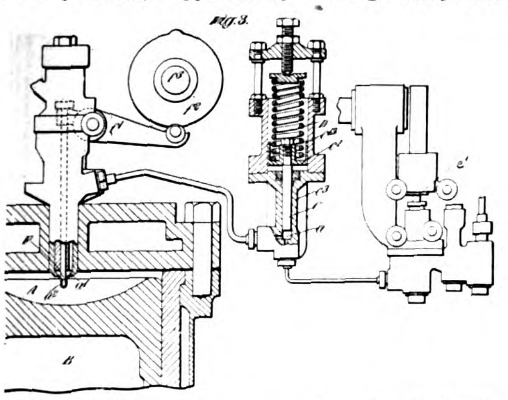
***Compiled and described by H. Schreck, Member American Society Mechanical Engineers**

1,079,422. Nov. 25, 1913. Solid Injection. J. McKechnie, of Barrow-In-Furness, England. Assignor to Vickers Ltd., of Barrow-In-Furness, England.

This invention relates to a special design for introducing mechanically the fuel into the cylinder, that is, without air injection. The fuel is injected as a



spray through a number of very fine holes and under an extremely high spring pressure in such a manner that on entering the cylinder (the compression pressure is considerably less than that of the liquid) the fuel spray instantly vaporizes owning to the sudden reduction of pressure, supported by the high temperature



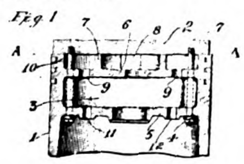
of the compressed air in the cylinder. The fuel which is delivered by the plunger e1 of the fuel measuring pump raises the fuel actuating plunger C against the pressure of the spring D and itself becomes subject to heavy pressure. As soon as the needle valve F is being opened the compressed spring forces the fuel into the cylinder.

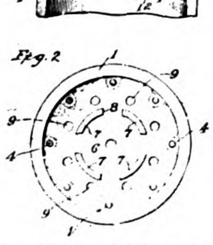
In case the engine has no needle valves an arrangement as shown in fig. 1 is employed on which between the cylinder and the actuating plunger a valve e is interposed which will be forced open by the force of spring D at the instant when its release will be effected by the revolving cam 7.

The solid injection has been developed and is being used on the Vickers Diesel-engine and we refer in this connection to the article on page 21 of our July issue.

1,226,631. May 22, 1917. Piston Design. A. Bie, of Winterthur, Switzerland. Assignor to Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, Mo.

This invention relates to a special design of a removable top plate of a water-cooled piston. The accompanying illustration is self-explanatory as to the features of this construction.

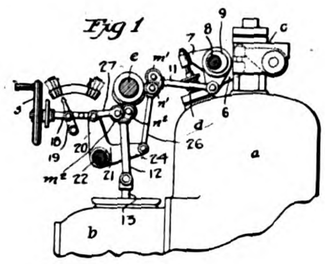


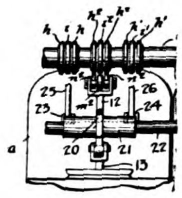


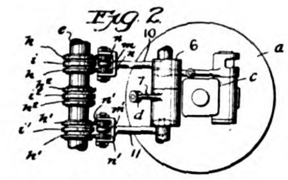
1,272,018. July 9, 1918. Valve Gearing. C. Dietze, of Winterthur, Switzerland. Assignor to Busch-Sulzer Bros.-Diesel Engine Co., of St. Louis, Mo.

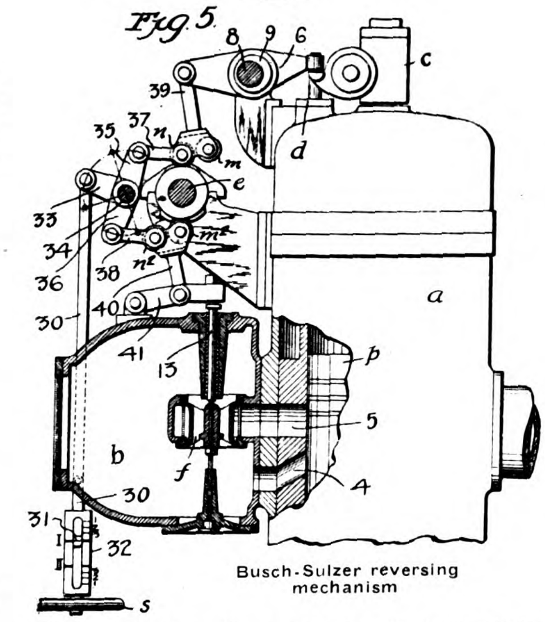
This invention relates to the reversing of internal-combustion engines. The construction provides for a single camshaft, both for forward and astern running, without the same being shifted.

For the purpose of symmetrical action upon the valve links three cams and three rollers are arranged for each valve, the outer rollers for running in one direction and a middle roller for the reverse direction. To engage or disengage in operation the fuel-valve c or the starting-valve respectively, as only one of these valves is in actual operation at the time, the bell-crank 21 has two arms 23 and 24 whose pivotally connected links 25 and 26 will put into operation either valve rockers 10-6 or 11-7.









Busch-Sulzer reversing mechanism

This construction allows also of a simple regulation of the fuel gear for a lighter or heavier load by shifting the mechanism to an appropriate degree. For further reference the article on pages 14 to 17 of our October issue may be consulted.

472,742. July 6, 1914. Reversing Gear. Societe des Anciens Establissements Weyher et Richemond, of Paris, France. (French Patent).

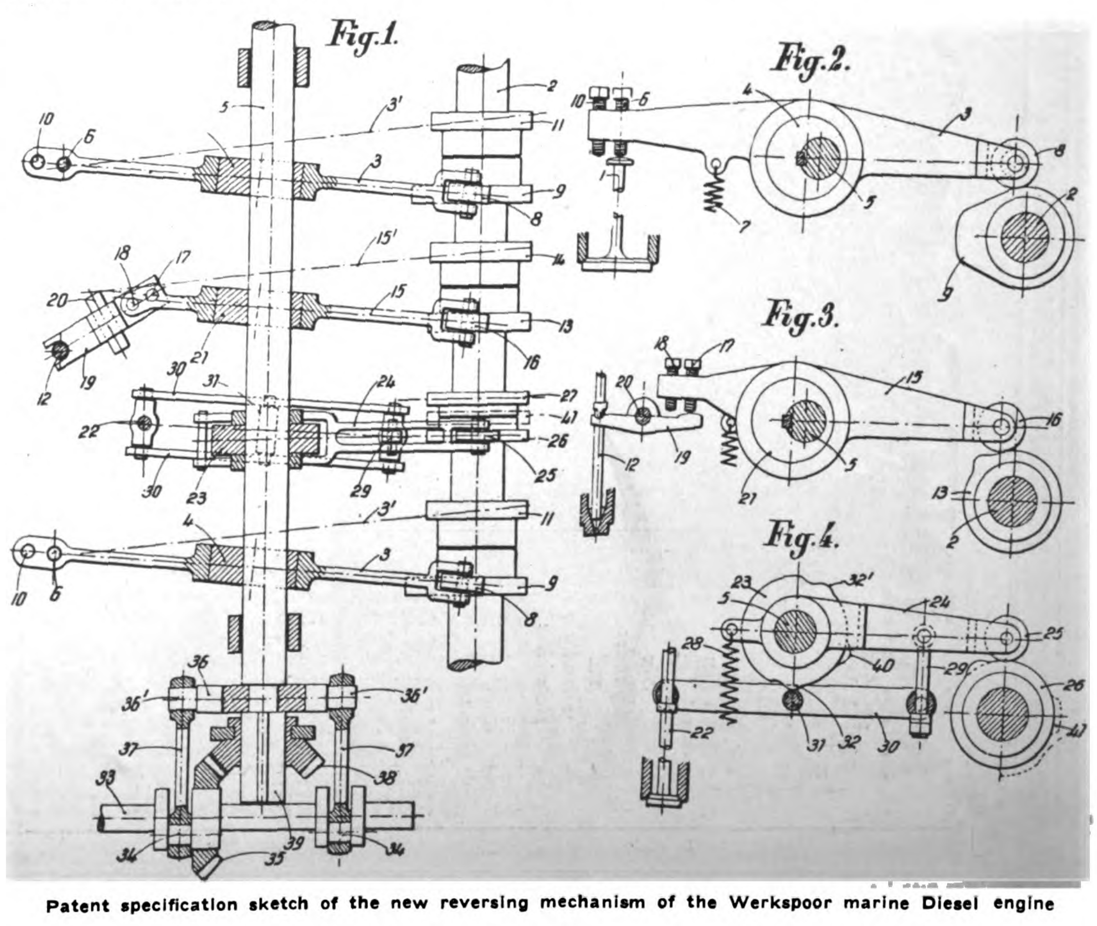
This invention refers to a novel arrangement of reversing internal-combustion engines on which the valve gearing is operated by cams or eccentrics, and is called after its inventor, the "Lugt system." The characteristics are one camshaft without any longitudinal motion, on it two cams for each valve, one for ahead and one for astern, and the valve rockers pivoted on accentrics whose axis are not parallel to its supporting shaft "5". For reversing, the rollers are being lifted from their cams by turning the shaft "5" which motion will at the same time shift the rocker-shaft longitudinally by means of the crank mechanism "34-37" and thus bring the cam rollers in contact with the second set of cams, which may be ahead or astern. The camshaft does not move.

Fig. 2 illustrates the arrangement for the inlet and exhaust valves, fig. 3 for the injection, and fig. 4 for the air starting valve. The latter will only be actuated when the cams 32 or 32¹ are holding down the auxiliary rocker "30." This motion will also be done and controlled by the turning of shaft "5." The cams "40 and 47," as shown in fig. 4, are provided only on three and four-cylinder engines as they serve to turn the engine only a very little in case the engine is being stopped and should come to rest at a point where none of the cylinders is in a proper starting position. (It will be remembered that almost all four-cycle engines have at least six cylinders in order to secure starting from any position of the crank).

At the valve end each rocker arm has two push screws which are required on account of the altered position of the rocker in its extreme positions.

The owner of this patent is the Paris licensee of of Werkspoor of Amsterdam, and the invention is of particular interest because it will be employed on 20 of the Werkspoor-Diesel-marine engines recently ordered by the United States Emergency Fleet Corporation from the Skandia-Pacific Oil Engine Co., of San Francisco, Cal., for installation in ten 5,500 ton d.w.c. motorships.

[Pressure on space has obliged us to hold over a number of interesting patents until December.—Editor.]



Patent specification sketch of the new reversing mechanism of the Werkspoor marine Diesel engine